

Australian Assassins, Part III: A review of the Assassin Spiders (Araneae, Archaeidae) of tropical north-eastern Queensland

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Abstract

The assassin spiders of the family Archaeidae from tropical north-eastern Queensland are revised, with eight new species described from rainforest habitats of the Wet Tropics bioregion and Mackay-Whitsundays Hinterland: *A. griswoldi* sp. n., *A. hoskini* sp. n., *A. karenae* sp. n., *A. tealei* sp. n., *A. thompsoni* sp. n., *A. wallacei* sp. n., *A. westi* sp. n. and *A. woodae* sp. n. Specimens of the only previously described species, *A. daviesae* Forster & Platnick, 1984, are redescribed from the southern Atherton Tableland. The rainforests of tropical eastern Queensland are found to be a potential hotspot of archaeid diversity and endemism, with the region likely to be home to numerous additional short-range endemic taxa. A key to species complements the taxonomy, with maps, natural history information and conservation assessments provided for all species.

Keywords

New species, taxonomy, conservation, Wet Tropics, rainforests, Palpimanoidea

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Introduction

Few families of Australian spiders are as distinctive or as enigmatic as the ‘assassin spiders’ of the family Archaeidae, renowned for their unique cephalic morphology, strange araneophagic biology, great phylogenetic antiquity and relictual biogeography across the Southern Hemisphere. Although once considered to be one of the rarest of spiders families – and certainly one of the least understood in terms of taxonomy, phylogeny and biology – recent and ongoing research in the U.S.A., South Africa and Australia has shed increasing light on this remarkable lineage of spiders (see Platnick 1991a, 1991b, Lotz 1996, 2003, 2006, Harvey 2002a, Griswold et al. 2005, Wood et al. 2007, Wood 2008, Rix and Harvey 2011, 2012a, 2012b, Wood et al. in press). Indeed, archaeids are now one of the better understood families of Araneae, with the southern African and Malagasy faunas continuing to be revised and phylogenetically tested, and the Australian fauna now almost completely revised taxonomically and phylogenetically. The last 20 years have seen large numbers of new species discovered and described in both the Afro-Malagasy and Australian regions (Platnick 2012), and archaeids (and their relatives) continue to feature heavily in studies exploring the classification and phylogeny of the basal Araneo-morphae (e.g. Schütt 2000, Griswold et al. 2005, Rix et al. 2008, Wood et al. in press).

Australian Archaeidae have been progressively revised over the last two years, with 26 new species described since 2011, taking the total number of currently described Australian species to 30 (Platnick 2012). Rix and Harvey (2011) first documented the Archaeidae of ‘mid-eastern’ Australia, re-describing the only previously named species from the region, and describing 17 new species from south-eastern Queensland and eastern New South Wales. This revision first noted the possibility of two major taxonomic, phylogenetic and biogeographic disjunctions in eastern and southern Australia, highlighting the St Lawrence Gap (Webb and Tracey 1981) in central eastern Queensland, and the Australian Alps in south-eastern Australia as likely candidates (see Fig. 2). Subsequent molecular phylogenetic research by Rix and Harvey (2012b) tested and further confirmed these phylogenetic disjunctions, highlighting especially the allopatric separation of a deeply-divergent southern Australian (i.e. Victorian, South Australian and Western Australian) lineage from all other eastern Australian taxa. Rix and Harvey (2012b) also confirmed the importance of the St Lawrence Gap, between Gladstone and Mackay, as an important phylogenetic and biogeographic barrier between monophyletic clades of *Austrarchaea* Forster & Platnick, 1984 from tropical north-eastern Queensland and mid-eastern Australia (see Figs 2–3); a result congruent with morphological observations by Rix and Harvey (2011, figs 5E–G). A second taxonomic revision by Rix and Harvey (2012a) formally documented the distinctive southern Australian lineage, describing the new genus *Zephyrarchaea* Rix & Harvey, 2012a, along with nine new species from south-western Western Australia, Kangaroo Island (South Australia) and southern Victoria. As a result of these monographic and phylogenetic revisions, a surprisingly diverse Australian archaeid fauna has now been revealed, one dominated by large numbers of mostly allopatric, short-range endemic species, all of which are restricted to the ‘mesic zone’ (Byrne et al. 2011) of mainland Australia. Archaeids are

ubiquitous in the tropical and subtropical upland rainforests of eastern Australia, and only those species from north of the St Lawrence Gap remain to be revised (Fig. 2).

The current paper – the third and final in a series revising the Archaeidae of Australia – presents a taxonomic revision of the assassin spiders from tropical north-eastern Queensland, including those species from the Mackay-Whitsundays Hinterland and the Wet Tropics bioregion, between Cooktown and Townsville (Figs 2, 25). This revision takes the total number of described Australian Archaeidae to 38 species, with the genus *Austrarchaea* now including 27 described short-range endemic species.

Material and methods

All taxa were described and illustrated from specimens stored in 75% or 95% ethanol. Digital images were taken using a Leica MZ16A binocular microscope and a Leica DM2500 compound microscope, with auto-montage images captured using Leica DFC500 mounted cameras with Leica Application Suite Version 3.6.0 software. Male left pedipalps were dissected prior to imaging and bulbs were aligned for standardised comparison in the ventral and retrolateral positions illustrated. Female genitalia were dissected and cleared in a 10% lactic acid plus 90% glycerol solution, prior to mounting on temporary glass slides and imaging in a postero-ventral position (Fig. 14G; see also Rix and Harvey 2011, fig. 5D), usually with genital plates removed (Fig. 7G). This postero-ventral alignment allowed for a much clearer presentation of the spermathecae, while still permitting inter-specific comparison at an equivalent (albeit opposite) plane to that of Rix and Harvey (2011, 2012a). Illustrations were made on Utoplex tracing paper, using printed template auto-montage images. Maps were generated using ArcMap version 9.3.1 (ESRI Inc.) with Virtual Earth (Microsoft Corp.).

Measurements are in millimetres (rounded to the nearest hundredth of a millimetre) and were taken using an ocular graticule on a Leica M80 binocular microscope. Left legs were removed from specimens prior to taking measurements and imaging lateral body profiles. Lateral profile images were standardised for inter-specific comparison by vertically aligning the centre of each left anterior median eye with the lower anterior margin of the carapace (above the labrum) (Rix and Harvey 2011, 2012a). Carapace height was measured in lateral view, from the margin of the pars thoracica above coxa II to the highest point of the pars cephalica (Fig. 5). Carapace length was measured from the lower anterior margin of the carapace (above the labrum) to the posterior margin of the pars thoracica (above the pedicel) (Fig. 5). ‘Neck’ width was measured in lateral view, at the narrowest point of the carapace, with total length, carapace width, abdomen length and abdomen width all measured in dorsal view. To quantify inter-specific variation in the shape of the cephalothorax and ‘head’, three morphometric ratios (the *carapace height to carapace length* [CH/CL] ratio; the *post-ocular ratio* [P.O. ratio]; and the *highest point of pars cephalica* [HPC] to *post-ocular length ratio*) were derived from lateral profile images as defined and discussed by Rix and Harvey (2011, 2012a). For Material Examined sections, specimens not examined for the current revision, but currently housed at (or on loan to) the California Academy of Sci-

ences (due to ongoing research) are listed separately, with identifications confirmed by H. Wood; one additional, unseen vial (QMB S50322) was identified as *A. daviesae* according to geographic proximity (Fig. 16). Species descriptions and numbering of the pedipalpal sclerites follows Rix and Harvey (2011) (but see also Remarks, below).

Abbreviations used in the text are as follows:

CH/CL	Carapace height (CH) to carapace length (CL) ratio
F1/CL	Femur I length (F1) to carapace length (CL) ratio
HPC	Highest point of pars cephalica
HT 1-4	Abdominal hump-like tubercles 1-4
SEM	Scanning electron micrograph/s
TS 1-3	Tegular sclerites 1-3

Specimens described in this study are lodged at the following institutions:

AMS	Australian Museum, Sydney (G. Milledge)
ANIC	Australian National Insect Collection, Canberra (B. Halliday)
CASENT	California Academy of Sciences, San Francisco (C. Griswold, A. Carmichael)
QMB	Queensland Museum, Brisbane (R. Raven, O. Seeman)
WAM	Western Australian Museum, Perth (MSH, J. Waldock)

Taxonomy

Family Archaeidae Koch & Berendt, 1854

Genus *Austrarchaea* Forster & Platnick, 1984

<http://species-id.net/wiki/Austrarchaea>

Austrarchaea Forster & Platnick, 1984: 21; Rix and Harvey 2011: 14.

Type species. *Archaea nodosa* Forster, 1956, by original designation.

Diagnosis. Species of *Austrarchaea* can be distinguished from all southern Australian species of *Zephyrarchaea* by the significantly taller carapace (CH/CL ratio ≥ 2.0), by the presence of accessory setae on the distal bulge of the male cheliceral paturon, and by the fusion of the two conductor sclerites on the male pedipalp (Rix and Harvey 2012a, fig. 4). Australian Archaeidae are further distinguished from Old World taxa by the presence of numerous, clustered spermathecae in females (Fig. 7G), and by the presence of a long, wiry embolus on the pedipalp of males (Fig. 4).

Description. For a full generic description see Rix and Harvey (2011). For notes on genitalia and morphological differences among lineages of *Austrarchaea*, see Remarks (below).

Distribution. Species of *Austrarchaea* occur in mesic habitats throughout eastern Queensland and New South Wales (Fig. 3), usually in montane rainforests (Figs 1E–F), but also in lowland rainforests or wet eucalypt forests on or adjacent to the Great Dividing Range (Rix and Harvey 2011). In north-eastern Queensland, archaids occur throughout the Wet Tropics bioregion, from the Mount Finnigan Uplands (near Cooktown) south to Mount Elliot (near Townsville) (Figs 16–23, 25). In the Mackay and Whitsundays Hinterland region, archaids can be found in the Eungella National Park (near Mackay), north to Mount Dryander (south of Bowen) (Figs 24–25). The genus is not known to occur south or west of the Australian Alps (Fig. 2), which may be a vicariant biogeographic barrier between populations of *Austrarchaea* and *Zephyrarchaea* (Rix and Harvey 2012a, 2012b).

Composition. Nineteen described species – *A. alani* Rix & Harvey, 2011, *A. aleenae* Rix & Harvey, 2011, *A. binfordae* Rix & Harvey, 2011, *A. christopherei* Rix & Harvey, 2011, *A. clyneae* Rix & Harvey, 2011, *A. cunninghami* Rix & Harvey, 2011, *A. daviesae* Forster & Platnick, 1984, *A. dianneae* Rix & Harvey, 2011, *A. harmsi* Rix & Harvey, 2011, *A. helenae* Rix & Harvey, 2011, *A. judyae* Rix & Harvey, 2011, *A. mascordi* Rix & Harvey, 2011, *A. mcguiganae* Rix & Harvey, 2011, *A. milledgei* Rix & Harvey, 2011, *A. monteithi* Rix & Harvey, 2011, *A. nodosa* (Forster, 1956), *A. platnickorum* Rix & Harvey, 2011, *A. raveni* Rix & Harvey, 2011, *A. smithae* Rix & Harvey, 2011 – plus the eight new species from north-eastern Queensland: *A. griswoldi* sp. n., *A. hoskini* sp. n., *A. karenae* sp. n., *A. tealei* sp. n., *A. thompsoni* sp. n., *A. wallacei* sp. n., *A. westi* sp. n. and *A. woodae* sp. n.

Remarks. The genus *Austrarchaea* includes three major lineages in eastern Australia (Figs 3–4), each readily distinguished by the morphology of the abdomen and the structure of the male pedipalp (Fig. 4). The most widespread lineage (the *A. nodosa* species-group) occurs south of the St Lawrence Gap, from Kroombit Tops National Park in central Queensland, south to the Badja State Forest in southern New South Wales (Fig. 3); species in this lineage possess six dorsal hump-like tubercles on the abdomen and an exposed tegular cavity with a variably scutiform conductor (Fig. 4). The second, most restricted lineage (the *A. monteithi* lineage) is known only from the Gibraltar Range National Park in northern New South Wales (Fig. 3); the single known species, *A. monteithi*, possesses five dorsal hump-like tubercles on the abdomen and an exposed tegular cavity with a hooked conductor (Fig. 4). The third lineage (the *A. daviesae* species-group; revised in this paper) occurs north of the St Lawrence Gap, from Eungella National Park north to Cooktown (Figs 3, 25); species in this lineage possess only four dorsal hump-like tubercles on the abdomen (recumbent in *A. woodae* sp. n.) and a more enclosed tegular cavity with a very large, arched conductor (Figs 4, 6–15).

Although the derived pedipalpal morphology of *A. daviesae* and its relatives is strikingly different to that of congeners further south, the distal tegular sclerites can nonetheless be broadly homologised with those of *A. nodosa* and *A. monteithi* on the basis of their shape and relative position in the unexpanded tegular cavity. The embolus in all nine known north-eastern Queensland species is a long, sinuous, strongly sclerotized process

emerging from the distal bulb pro-ventrally, in some species bearing an additional accessory spur. Tegular sclerite 3 (TS 3) is always a prominent, pro-ventrally directed process, which is fused to the retro-ventral margin of the tegular bulb (the latter of which is usually also concomitantly modified). Tegular sclerite 2 (plus 2a, i.e. TS 2-2a) is usually inserted just behind TS 3 in the unexpanded tegular cavity, forming a distinctive, mesally-looped and distally whip-like structure common to all taxa in the *A. daviesae* species-group; the extent of this very long, whip-like TS 2a is usually proximate to the distal extension of the embolus in the unexpanded state. This TS 2-2a morphology is in stark contrast to that of *A. monteithi*, *A. nodosa* and related species, in which TS 2a is usually covered and largely obscured by a more spur-like TS 2 process. Tegular sclerite 1 (TS 1) – generally the most prominent sclerite in species of *Zephyrarchaea* and other species of *Austrarchaea* – is reduced and often obscured in most archaeid species from north-eastern Queensland, although a few taxa possess a larger, more distinctive TS 1 posterior to the TS 2-2a complex (e.g. Fig. 9D). Inter-specific variation among taxa in the *A. daviesae* species-group is pronounced, with male pedipalp morphologies usually highly autapomorphic for each species. Five broad pedipalp types (Types A-E) can be distinguished among north-eastern Queensland taxa, with Type A being the most common form, shared between five of the nine known species, and Types B-E each currently unique to single species. Figure 6 highlights differences between these different pedipalp morphologies, which are further diagnosed in the Key to species (see below).

Key to the species of *Austrarchaea* known from north-eastern Queensland (males required)

- 1 Distal embolus enclosed within conductor (Fig. 12D); pedipalp very small, width of bulb $\ll$ 0.30 mm (Fig. 12D) (**Type B** pedipalp; Fig. 6) *A. westi* sp. n.
- Distal embolus fully exposed, projecting distally, not enclosed within conductor (Figs 7E, 13D, 15E); pedipalp larger, width of bulb $>$ 0.30 mm..... **2**
- 2 Conductor arched, directed prolaterally in ventral view (Fig. 14E); tegular sclerite 3 (TS 3) very large, dagger-like, directed pro-ventrally across bulb (Figs 14E-F); embolus with prominent, rounded, fin-shaped spur (Fig. 14E) (**Type D** pedipalp; Fig. 6)..... *A. boskini* sp. n.
- Conductor directed retrolaterally in ventral view (Figs 7E, 8D, 10D); tegular sclerite 3 (TS 3) not dagger-like; embolic spur, if present, with pointed apex (Figs 9E, 11F)..... **3**
- 3 Distal bulb and proximal conductor strongly constricted laterally, forming uniquely apple-shaped pedipalpal profile in ventral view (Figs 13C–D); tegular sclerite 3 (TS 3) large, flattened, with prominent, distally folded apex (Figs 13D-E) (**Type C** pedipalp; Fig. 6) *A. woodae* sp. n.
- Distal bulb and proximal conductor not constricted laterally; tegular sclerite 3 (TS 3) not folded distally..... **4**
- 4 Vento-distal rim of tegulum distally extended to form rectangular opercular plate, covering tegular sclerite 2a (TS 2a) for most of its length (Fig. 15E);

- tegular sclerite 3 (TS 3) very large, flattened, extending along entire retrolateral edge of conductor (Fig. 15F) (**Type E** pedipalp; Fig. 6)*A. griswoldi* sp. n.
- Ventro-distal rim of tegulum not forming rectangular opercular plate; tegular sclerite 3 (TS 3) shorter, spur-like (Figs 7E, 8D, 9D, 10D, 11E); conductor arched, directed retrolaterally in ventral view, not abutting TS 3 (Figs 7E, 9D, 10D, 11E) (**Type A** pedipalp; Fig. 6) **5**
- 5 Embolus with triangular embolic spur (Figs 8D, 9E, 10D, 11F); embolus projecting beyond distal rim of conductor by > 1/3 length of exposed embolic portion (Figs 9D, 10D, 11E) **6**
- Embolus without embolic spur (Fig. 7E); embolus projecting beyond distal rim of conductor by ~1/3 length of exposed embolic portion (Figs 7D–E)
.....*A. daviesae* Forster & Platnick, 1984
- 6 Embolic spur distally positioned, situated close to pro-distal margin of conductor (slightly proximal to distal-most curve of embolus tip) (Figs 9D, 11E); tegular sclerite 1 (TS 1) relatively large, triangular, visible in ventral view posterior to TS 2–3 (Figs 8D, 9D, 11E) **7**
- Embolic spur more proximally positioned, situated near base of exposed embolic portion (Fig. 10D); tegular sclerite 1 (TS 1) small, obscured by TS 2–3, not visible in ventral view (Fig. 10D) *A. thompsoni* sp. n.
- 7 Tegular sclerite 3 (TS 3) with sharply pointed, claw-like apex (Figs 9D–E, 11E–F) **8**
- Tegular sclerite 3 (TS 3) with more bluntly pointed, triangular apex (Figs 8C–D) *A. wallacei* sp. n.
8. Tegular sclerite 1 (TS 1) broadly triangular in ventral view (Fig. 9D); tegular sclerite 3 (TS 3) with single, sharply pointed process distally (Fig. 9D)
.....*A. karenae* sp. n.
- Tegular sclerite 1 (TS 1) with more tapered, tooth-like triangular apex in ventral view (Fig. 11E); tegular sclerite 3 (TS 3) with second short, pointed process distally (Fig. 11E) *A. tealei* sp. n.

The Wet Tropics fauna

Austrarchaea daviesae Forster & Platnick, 1984

http://species-id.net/wiki/Austrarchaea_daviesae

Misty Mountains Assassin Spider

Figs 7, 16, 25

Austrarchaea daviesae Forster & Platnick, 1984: 22, figs 66–68, 70–75.

Type material. Holotype male: Majors Mountain, [Tully Falls National Park], Atherton Tableland, Queensland, Australia, [17°38'25"S, 145°32'14"E], collected at night, 14–20.IV.1978, V. Davies, R. Raven (QMB S1091).

Paratypes: Allotype female, "Malaan State Forest" [= Malaan National Park], Atherton Tableland, Queensland, Australia, [17°35'S, 145°35'E], 20–24.IV.1978, V. Davies, R. Raven (QMB S1092).

Other material examined. AUSTRALIA: Queensland: Tully Falls National Park (Atherton Tableland): Massey Creek, 17°37'S, 145°34'E, flight intercept trap, 1000 m, 2–30.V.1996, P. Zborowski, 1♀ (ANIC). **Malaan National Park (Atherton Tableland):** "Malaan State Forest", on Highway, 17°35'S, 145°35'E, pitfall trap, 850 m, 7.III.–15.V.1995, G. Monteith, J. Hasenpusch, 1 juvenile (QMB S38624); Mount Fisher, 7 km SW. of Millaa Millaa, pyrethrum knockdown, 1050–1100 m, 27–29.IV.1982, G. Monteith, D. Yeates, D. Cook, 1 juvenile (QMB S30838); next to Old Palmerston Highway, opposite Biggs Road, SSW. of Millaa Millaa, 17°35'11"S, 145°34'57"E, sifting elevated leaf litter at base of lawyer vine palms, tropical rainforest, 969 m, 18.III.2012, M. & A. Rix, 1♂, 1♀ (WAM T125183). **Wooroonooran National Park:** Mount Bartle Frere, inside Upper Boulder Caves, 17°23'S, 145°47'E, 1000 m, 12.V.1995, G. Monteith, D. Slaney, 1♀ (QMB S72989); same data except outside Lower Boulder Caves, 900 m, 13.V.1995, 1♀ (QMB S72987).

Other material (not examined). AUSTRALIA: Queensland: Atherton Tableland: Bally Knob, summit, 17°39'S, 145°30'E, flight intercept trap, 1100 m, 6.XII.1998–6.II.1999, G. Monteith, D. Cook, 2♀ (QMB S50332). **Wooroonooran National Park:** Mount Bartle Frere, on track to summit, western side, from Junction Camp carpark off Gourka Road, 17°22'42"S, 145°47'09"E, day collecting, beating high and low vegetation, rainforest, 700–1300 m, 23–26.IV.2009, H. Wood, 3♂, 1♀ (CASENT 9034523); same data, 1♂ (CASENT 9034522); same data, 1 juvenile (CASENT 9034511); same data except day collecting, sifting leaf litter and small logs, brushing logs, mini-winkler, 1♀ (CASENT 9028381); Mount Bartle Frere, 18.4 km E. of Malanda, 17°22'46"S, 145°45'46"E, rainforest, 690–800 m, 17.III.2006, C. Griswold, D. Silva, M. Ramírez, 1 juvenile (CASENT 9023672).

Diagnosis. *Austrarchaea daviesae* can be distinguished from all other Archaeidae from north-eastern Queensland by the absence of a spur on the embolus (Fig. 7E) combined with a Type A pedipalp morphology (Fig. 6), i.e. with a large, arched, retro-laterally directed conductor (Figs 6, 7E), exposed embolus (Figs 6, 7E) and relatively short, spur-like tegular sclerite 3 (TS 3). This species can be further distinguished by the unique shape of TS 3, which has a broad tegular base and strongly hooked apex (Figs 7D–F; see also Forster and Platnick 1984, figs 70–72, 74), and by the relatively short embolus, which projects beyond the distal rim of the conductor by ~1/3 the length of the exposed embolic portion (Figs 7D–E).

Description. *Holotype male:* Total length 2.74; leg I femur 2.73; F1/CL ratio 2.38. Cephalothorax tan-brown; legs pale tan-brown with darker annulations; abdomen mottled tan-brown and yellowish-beige (colour faded due to preservation) (Fig. 7B). Carapace tall (CH/CL ratio 2.08); 1.15 long, 2.38 high, 1.08 wide, 'neck' 0.62 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of 'head' (ratio of HPC to post-ocular length 0.67), carapace gently

sloping posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.27). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 7C). Abdomen 1.54 long, 1.03 wide; with two pairs of dorsal hump-like tubercles (HT 1-4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3-4 each covered by separate dorsal sclerites. Unexpanded pedipalp (of WAM T125183) (Figs 7D–F; see Forster and Platnick 1984, figs 70–74 for SEM images of unexpanded holotype pedipalp) of Type A morphology (Fig. 6), with large, retrolaterally directed, arched conductor; embolus distally directed, slightly sinuous, without spur, projecting beyond distal rim of conductor by $\sim 1/3$ length of exposed embolic portion; tegular sclerite 3 (TS 3) short, spur-like, with broad tegular base and strongly hooked apex; TS 2-2a looped over retrolateral edge of conductor, TS 2 not strongly developed distally, TS 2a projecting beyond distal rim of conductor to just past tip of embolus; TS 1 very small, obscured by TS 2-3, not visible in ventral view.

Female (WAM T125183): Total length 3.44; leg I femur 2.97; F1/CL ratio 2.32. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled dark grey-brown and beige (Fig. 7A). Carapace tall (CH/CL ratio 2.11); 1.28 long, 2.71 high, 1.21 wide; 'neck' 0.71 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of 'head' (ratio of HPC to post-ocular length 0.63), carapace gently sloping posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.26). Chelicerae without accessory setae on anterior face of paturon. Abdomen 1.54 long, 1.37 wide; with four pairs of dorsal hump-like tubercles (HT 1-4). Internal genitalia (Fig. 7G) with cluster of 4-5 variably-shaped spermathecae on either side of gonopore, clusters widely separated along midline of genital plate; innermost (anterior) spermathecae longest, sausage-shaped, bent laterally; other spermathecae variably sausage-shaped or pyriform; posterior pair of spermathecae slightly separated posteriorly.

Variation: Males (Atherton Tableland; $n = 2$): total length 2.74–3.23; carapace length 1.15–1.18; carapace height 2.38–2.56; CH/CL ratio 2.08–2.17. Females (Atherton Tableland; $n = 3$): total length 3.44–3.49; carapace length 1.26–1.32; carapace height 2.7–2.77; CH/CL ratio 2.10–2.15. Females (Mount Bartle Frere; $n = 2$): total length 3.64–3.79; carapace length 1.40 (invariable); carapace height 2.97 (invariable); CH/CL ratio 2.13 (invariable). Although female specimens from Mount Bartle Frere appear to be slightly larger than those from further west (Fig. 5), carapace proportions and genitalia seem otherwise very similar to specimens from the Atherton Tableland (see Remarks, below).

Distribution and habitat. *Austrarchaea daviesae* is known from the 'Misty Mountains' region of the southern Atherton Tableland, in the vicinity of Ravenshoe and Millaa Millaa, with additional specimens also known from Mount Bartle Frere in the adjacent Wooroonooran National Park (see Remarks, below) (Figs 16, 25). Specimens have been collected in pitfall and flight intercept traps, by beating vegetation, or by beating and sifting elevated leaf litter at the bases of lawyer vine palms (*Calamus* spp.) in dense tropical rainforest (Fig. 1F).

Conservation status. This species has a relatively widespread distribution in several National Parks protected under World Heritage legislation, and is not considered to be of conservation concern.

Remarks. The identification and distribution of *Austrarchaea daviesae* has, until recently, been difficult to ascertain, as the holotype male (QMB S1091; Fig. 7B) is without pedipalps (these presumably having been mounted on SEM stubs as per Forster and Platnick 1984, figs 70–74). Similarly, no adult male specimens had been collected from the Atherton Tableland since the original holotype collection in 1978. Fortunately, an adult male and female were collected in early 2012, from the paratype locality (Malaan National Park), near the type locality of Majors Mountain. These specimens (WAM T125183), described above, closely conform to original descriptions, and the male pedipalp appears indistinguishable from that illustrated in Forster and Platnick (1984, figs 70–74). Interestingly, the distribution of *A. daviesae* appears to extend beyond the Atherton Tableland, with eastern populations apparently sympatric or at least partly sympatric with *A. woodae* sp. n. on Mount Bartle Frere, in the Wooroonooran National Park. Adult Mount Bartle Frere specimens collected by the California Academy of Sciences in 2009 are conspecific with specimens from Malaan National Park, as confirmed by pedipalp images supplied by H. Wood (pers. comm.). Another juvenile specimen from Mount Bartle Frere (CASENT 9023672), collected in 2006, is also conspecific with these adult Mount Bartle Frere specimens, as determined by almost identical *COI* sequences (H. Wood, pers. comm.). Interestingly, female specimens collected by the QM from Boulder Caves, near the type locality of *A. woodae* sp. n., also appear to be *A. daviesae* (rather than *A. woodae* sp. n.), due to the presence of fully developed (rather than recumbent) abdominal tubercles, and a similar carapace morphology and similar genitalia to specimens from the Atherton Tableland. *Austrarchaea woodae* sp. n. thus appears to be much rarer than *A. daviesae* at altitudes ≤ ~1000 m, and may actually be restricted to higher altitude montane rainforest on the summit of Mount Bartle Frere.

***Austrarchaea wallacei* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:0368CE32-E6E8-4D49-A0C0-1FD3DEFCAC23

http://species-id.net/wiki/Austrarchaea_wallacei

Mount Misery Assassin Spider

Figs 8, 17, 25

Type material. Holotype male: Mount Misery, summit, [Monkhouse Timber Reserve], Queensland, Australia, 15°52'S, 145°14'E, pitfall trap, 850 m, 6.XII.1990–17.I.1991, Queensland Museum & ANZSES (QMB S25964).

Etymology. The specific epithet is a patronym in honour of the late Doug Wallace OAM (1923–2012), for his passion and enthusiasm for arachnology, for his contributions to the study of Australian (and especially Queensland) spiders, for his efforts in founding and fostering the Rockhampton Arachnological Society, and for his encouragement of MGR over many years.

Diagnosis. *Austrarchaea wallacei* can be distinguished from all other Archaeidae from north-eastern Queensland except *A. karenae* sp. n., *A. tealei* sp. n. and *A. thomp-*

soni sp. n. by the presence of a triangular spur on the embolus (Fig. 8D); from *A. thompsoni* sp. n. by the presence of a prominent, triangular tegular sclerite 1 (TS 1) (Fig. 8D); and from *A. karenae* sp. n. and *A. tealei* sp. n. by the shape of tegular sclerite 3 (TS 3), which has a bluntly pointed, triangular apex (Figs 8C–D).

Description. *Holotype male*: Total length 3.28; leg I femur 3.01; F1/CL ratio 2.58. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 8A). Carapace tall (CH/CL ratio 2.14); 1.17 long, 2.49 high, 1.10 wide, ‘neck’ 0.62 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) approaching posterior quarter of ‘head’ (ratio of HPC to post-ocular length 0.72), carapace gently sloping posterior to HPC; ‘head’ moderately elevated dorsally (post-ocular ratio 0.33). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 8B). Abdomen 1.59 long, 1.28 wide; with two pairs of dorsal hump-like tubercles (HT 1–4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3–4 each covered by separate dorsal sclerites. Expanded pedipalp (Figs 8C–D) of Type A morphology (Fig. 6), with large, retrolaterally directed, arched conductor; embolus sinuous, with short triangular spur; tegular sclerite 3 (TS 3) short, spur-like, with flattened proximal portion and bluntly pointed, triangular apex; TS 2–2a flexed dorsally (due to haematodochal expansion), TS 2 with pointed apex; TS 1 triangular, with tapered, slightly curved tooth-like apex.

Female: Unknown.

Distribution and habitat. *Austrarchaea wallacei* is known only from the summit of Mount Misery, 34 km north-west of Cape Tribulation (Figs 17, 25). The single known specimen was collected in a pitfall trap in tropical rainforest at 850 m elevation.

Conservation status. Unknown (data deficient).

***Austrarchaea karenae* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:E010DAB8-9909-432E-BAA9-0452A1EBCCE0

http://species-id.net/wiki/Austrarchaea_karenae

Windsor Tableland Assassin Spider

Figs 9, 18, 25

Type material. Holotype male: Windsor Tableland, [Windsor Tableland National Park], 1.2 km past barracks, Queensland, Australia, 16°15'S, 145°02'E, QM berlesate, stick brushing, rainforest, 1060 m, 24.XI.1997, G. Monteith (QMB S43060).

Etymology. The specific epithet is a patronym in honour of Dr Karen Edward, for her contributions to our understanding of Wet Tropics biogeography, and for her great friendship to MGR and MSH over many years.

Diagnosis. *Austrarchaea karenae* can be distinguished from all other Archaeidae from north-eastern Queensland except *A. tealei* sp. n., *A. thompsoni* sp. n. and *A. wallacei* by the presence of a triangular spur on the embolus (Figs 9D–E); from *A. thompsoni* sp. n. by the presence of a prominent, triangular tegular sclerite 1 (TS 1), which is vis-

ible in ventral view (Fig. 9D); and from *A. tealei* sp. n. and *A. wallacei* by the shape of regular sclerite 3 (TS 3), which has a single, sharply pointed process distally (Fig. 9D).

Description. *Holotype male*: Total length 2.97; leg I femur 3.17; F1/CL ratio 2.74. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 9A). Carapace tall (CH/CL ratio 2.12); 1.15 long, 2.49 high, 1.09 wide, 'neck' 0.61 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of 'head' (ratio of HPC to post-ocular length 0.65), carapace gently sloping posterior to HPC; 'head' moderately elevated dorsally (post-ocular ratio 0.32). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 9B). Abdomen 1.59 long, 1.13 wide; with two pairs of dorsal hump-like tubercles (HT 1-4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3-4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 9C-E) of Type A morphology (Fig. 6), with large, retrolaterally directed, arched conductor; embolus distally directed, slightly sinuous, with short triangular spur adjacent to distal rim of conductor, embolus projecting beyond distal rim of conductor by $\sim 1/2$ length of exposed embolic portion; regular sclerite 3 (TS 3) short, spur-like, with flattened proximal portion and sharply pointed, claw-like apex; TS 2-2a looped over retrolateral edge of conductor, TS 2 with pointed, subtriangular apex, TS 2a projecting beyond distal rim of conductor but not extending to near tip of embolus; TS 1 broadly triangular in ventral view.

Female: Unknown.

Distribution and habitat. *Austrarchaea karenae* is known only from the Windsor Tableland, 44 km north-west of Mossman (Figs 18, 25). The single known specimen was collected in high altitude tropical rainforest.

Conservation status. Unknown (data deficient).

***Austrarchaea thompsoni* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:CC84B06D-AD54-41A7-8237-F2031D57F0A7

http://species-id.net/wiki/Austrarchaea_thompsoni

Carbine Tableland Assassin Spider

Figs 10, 19, 25

Type material. Holotype male: Devils Thumb area, [Daintree National Park (Mossman Gorge Section)], 10 km NW. of Mossman, Queensland, Australia, [16°27'S, 145°17'E], pyrethrum knockdown, tropical rainforest, 1000–1180 m, 10.X.1982, G. Monteith, D. Yeates, G. Thompson (QMB S30840).

Etymology. The specific epithet is a patronym in honour of Geoff Thompson, for his ongoing efforts in collecting and documenting the invertebrate rainforest fauna of the Wet Tropics, and for collecting the only known specimen of this species.

Diagnosis. *Austrarchaea thompsoni* can be distinguished from all other Archaeidae from north-eastern Queensland except *A. karenae*, *A. tealei* sp. n. and *A. wallacei* by the

presence of a triangular spur on the embolus (Fig. 10D); and from *A. kareniae*, *A. tealei* sp. n. and *A. wallacei* by the very small tegular sclerite 1 (TS 1), which is not visible in ventral view (Fig. 10D), and by the more proximally positioned embolic spur, which is situated near the base of the exposed embolic portion (Fig. 10D).

Description. *Holotype male*: Total length 2.97; leg I femur 3.23; F1/CL ratio 2.74. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 10A). Carapace tall (CH/CL ratio 2.13); 1.18 long, 2.51 high, 1.13 wide, ‘neck’ 0.63 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of ‘head’ (ratio of HPC to post-ocular length 0.69), carapace gently sloping posterior to HPC; ‘head’ not strongly elevated dorsally (post-ocular ratio 0.25). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 10B). Abdomen 1.64 long, 1.23 wide; with two pairs of dorsal hump-like tubercles (HT 1–4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3–4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 10C–E) of Type A morphology (Fig. 6), with large, retrolaterally directed, arched conductor; embolus distally directed, slightly sinuous, with short triangular spur situated near base of exposed embolic portion, embolus projecting beyond distal rim of conductor by slightly less than 1/2 length of exposed embolic portion; tegular sclerite 3 (TS 3) short, spur-like, with constricted tegular base and sharply pointed, claw-like apex; TS 2–2a looped beneath overhanging retrolateral edge of conductor, TS 2 with rounded, subtriangular apex, TS 2a projecting beyond distal rim of conductor to near tip of embolus; TS 1 very small, obscured by TS 2–3, not visible in ventral view.

Female: Unknown.

Distribution and habitat. *Austrarchaea thompsoni* is known only from Devils Thumb, on the Carbine Tableland 10 km west-north-west of Mossman (Figs 19, 25). The single known specimen was collected in high altitude tropical rainforest.

Conservation status. Unknown (data deficient).

***Austrarchaea tealei* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:60D9ADD6-1BDB-4964-B484-99587C772CAB

http://species-id.net/wiki/Austrarchaea_tealei

Mossman Gorge Assassin Spider

Figs 11, 20, 25

Austrarchaea sp. n. ‘(NEQ-1)’ Rix and Harvey 2012b: 379, figs 3, 5–7.

Type material. Holotype male: Daintree National Park (Mossman Gorge Section), Mossman Gorge, off water access road ~50 m from carpark, Queensland, Australia, 16°28'20"S, 145°19'53"E, sifting elevated leaf litter under lawyer vine palms, tropical rainforest, 78 m, 21.III.2012, M. & A. Rix (QMB S92210).

Other material examined. AUSTRALIA: Queensland: Daintree National Park (Mossman Gorge Section): Mossman Gorge, [16°28'20"S, 145°19'53"E], 23.IV.1967, D. Colless, 1♀ (ANIC); Mossman Gorge, Water Access Track, Site 2, 16°28'28"S, 145°19'41"E, sieved litter from around roots and rocks on shady steep section of bank, tropical rainforest, 1.IV.2009, K. Edward, J. Waldock, 1 juvenile (WAM T97462).

Other material (not examined). AUSTRALIA: Queensland: Daintree National Park (Mossman Gorge Section): Mossman Gorge, carpark, 16°28'20"S, 145°19'52"E, day collecting, turning over logs, rainforest, 45 m, 17–18.IV.2009, H. Wood, 4♂, 2♀ (CASENT 9028385).

Etymology. The specific epithet is a patronym in honour of Roy Teale, for his friendship to MSH, for his efforts in facilitating systematic research at the Western Australian Museum, and for his crucial support of the Western Australian Museum's 'archaeid project' since 2007.

Diagnosis. *Austrarchaea tealei* can be distinguished from all other Archaeidae from north-eastern Queensland except *A. karenae*, *A. thompsoni* and *A. wallacei* by the presence of a triangular spur on the embolus (Figs 11E–F); from *A. thompsoni* by the presence of a prominent, triangular tegular sclerite 1 (TS 1), which is visible in ventral view (Fig. 11E); and from *A. karenae* and *A. wallacei* by the shape of tegular sclerite 3 (TS 3), which has a second short, pointed process distally (Fig. 11E).

Description. *Holotype male:* Total length 2.67; leg I femur 3.09; F1/CL ratio 2.85. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled dark grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 11B). Carapace tall (CH/CL ratio 2.17); 1.08 long, 2.35 high, 1.00 wide, 'neck' 0.54 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) approaching posterior quarter of 'head' (ratio of HPC to post-ocular length 0.71), carapace gently sloping posterior to HPC; 'head' moderately elevated dorsally (post-ocular ratio 0.30). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 11C). Abdomen 1.44 long, 1.05 wide; with two pairs of dorsal hump-like tubercles (HT 1–4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3–4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 11D–F) of Type A morphology (Fig. 6), with large, retrolaterally directed, arched conductor; embolus distally directed, slightly sinuous, with short triangular spur adjacent to distal rim of conductor, embolus projecting beyond distal rim of conductor by ~1/2 length of exposed embolic portion; tegular sclerite 3 (TS 3) short, spur-like, with flattened proximal portion and sharply pointed, claw-like apex bearing second short, pointed process distally; TS 2–2a looped over retrolateral edge of conductor, TS 2 with rounded, subtriangular apex, TS 2a projecting beyond distal rim of conductor but not extending to near tip of embolus; TS 1 triangular, with tapered, slightly curved tooth-like apex.

Female (ANIC): Total length 2.95; leg I femur 2.86; F1/CL ratio 2.37. Cephalothorax reddish-brown; legs pale tan-brown with darker annulations; abdomen mottled grey-brown and beige (Fig. 11A). Carapace tall (CH/CL ratio 2.04); 1.21 long, 2.46 high, 1.13 wide; 'neck' 0.69 wide; bearing two pairs of rudimentary horns; highest

point of pars cephalica (HPC) near posterior third of ‘head’ (ratio of HPC to post-ocular length 0.65), carapace gently sloping posterior to HPC; ‘head’ not strongly elevated dorsally (post-ocular ratio 0.23). Chelicerae without accessory setae on anterior face of paturon. Abdomen 1.64 long, 1.28 wide; with four pairs of dorsal hump-like tubercles (HT 1–4). Internal genitalia (Fig. 11G) with cluster of 4–6 variably-shaped spermathecae on either side of gonopore, clusters widely separated along midline of genital plate; innermost (anterior) spermathecae longest, sausage-shaped, bent laterally; other spermathecae variably sausage-shaped or pyriform, smallest anteriorly, becoming progressively larger posteriorly.

Distribution and habitat. *Austrarchaea tealei* is known only from Mossman Gorge, 4.5 km west-south-west of Mossman (Figs 20, 25). Specimens have been collected under logs (as newly-hatched juveniles; H. Wood, pers. comm.), or by beating and sifting elevated leaf litter at the bases of lawyer vine palms (*Calamus* spp.) in lowland tropical rainforest.

Conservation status. Unknown (data deficient).

Remarks. The female specimen described above (from the ANIC) is tentatively identified as conspecific with the holotype of *A. tealei*, despite a somewhat different carapace morphology and a fairly imprecise collection locality. *Austrarchaea thompsoni* does occur on nearby mountains above the Mossman River, and thus it possible (albeit unlikely) that the female specimen from “Mossman Gorge” (collected in 1967) may actually belong to another species. We have described it here in the absence of evidence suggesting any sympatry in the Mossman Gorge region, given the fact that all other recently collected Mossman Gorge material appears to be conspecific with the holotype (including CAS material; H. Wood, pers. comm.), and given the similarly small body size of this female specimen and the holotype male (Fig. 5).

***Austrarchaea westi* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:1D560E1E-96FB-4F5B-A826-281429ADD500

http://species-id.net/wiki/Austrarchaea_westi

Lamb Range Assassin Spider

Figs 12, 21, 25

Type material. Holotype male: Mount Williams, [Dinden National Park], 16°55'S, 145°40'E, pyrethrum, trees and logs, 1000 m, 2.XII.1993, G. Monteith, H. Janetzki (QMB S59537).

Other material examined. AUSTRALIA: **Queensland:** Dinden National Park: same data as holotype, 1 juvenile (QMB S59537).

Etymology. The specific epithet is a patronym in honour of Paul West, for his friendship to MSH over many years, and for helping fund the Western Australian Museum’s ‘archaeid project’ from 2009–2012.

Diagnosis. *Austrarchaea westi* can be distinguished from all other Archaeidae from north-eastern Queensland by the presence of a unique Type B pedipalp (Fig. 6), with

very small bulb (width < 0.30 mm) (Figs 6, 12D), and by the relatively short embolus, which is distally enclosed within the conductor (Figs 6, 12D). This species can be further distinguished by the very short, barely differentiated accessory setae on the male chelicerae (Fig. 12B).

Description. *Holotype male*: Total length 3.13; leg I femur 3.23; F1/CL ratio 2.65. Cephalothorax reddish-brown; legs beige with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 12A). Carapace tall (CH/CL ratio 2.15); 1.22 long, 2.62 high, 1.13 wide, 'neck' 0.65 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) approaching posterior quarter of 'head' (ratio of HPC to post-ocular length 0.71), carapace gently sloping posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.27). Chelicerae with very short, barely differentiated accessory setae on anterior face of paturon (Fig. 12B). Abdomen 1.65 long, 1.10 wide; with two pairs of dorsal hump-like tubercles (HT 1-4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3-4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 12C-E) of Type B morphology (Fig. 6), very small in size (width of bulb < 0.30), with large, retrolaterally directed, arched conductor; embolus curved, distally enclosed within conductor, without spur; tegular sclerite 3 (TS 3) porrect, spur-like, with pointed, pro-distally directed apex; TS 2-2a looped over retrolateral edge of conductor, TS 2 not strongly developed distally, TS 2a projecting beyond distal rim of conductor; TS 1 very small, obscured by TS 2-3, not visible in ventral view.

Female: Unknown.

Distribution and habitat. *Austrarchaea westi* is known only from Mount Williams, on the Lamb Range 11 km west of Cairns (Figs 21, 25). The two known specimens were collected in high altitude tropical rainforest.

Conservation status. Unknown (data deficient).

***Austrarchaea woodae* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:E4F1A9F7-33E3-4FCF-86CE-C14A1572F037

http://species-id.net/wiki/Austrarchaea_woodae

Mount Bartle Frere Assassin Spider

Figs 13, 22, 25

Type material. Holotype male: Mount Bartle Frere, [Wooroonooran National Park], Boulder Caves, Queensland, Australia, [17°23'S, 145°47'E], 1050 m, 8.XII.1990, G. Monteith, G. Thompson, D. Cook, R. Sheridan (QMB S72988).

Etymology. The specific epithet is a patronym in honour of Dr Hannah Wood, for her pioneering research into the systematics, biology and biogeography of assassin spiders and other Palpimanoidea, and for her collaborative support of MGR and MSH during assassin spider research conducted at the Western Australian Museum.

Diagnosis. *Austrarchaea woodae* can be distinguished from all other Archaeidae from north-eastern Queensland by the presence of a unique Type C pedipalp (Fig. 6), with a

proximally constricted conductor (Figs 6, 13D), large, flattened, distally folded tegular sclerite 3 (TS 3) (Figs 6, 13D–E), and apple-shaped bulb profile in ventral view (Figs 6, 13C–D). This species can be further distinguished by the dense, pick-like tuft of accessory setae on the male chelicerae (Fig. 13B; similar only to *A. harmsi* among Australian Archaeidae), and by the almost spherical abdomen with recumbent hump-like tubercles (Fig. 13A; similar only to species of *Zephyrarchaea* among Australian Archaeidae).

Description. *Holotype male*: Total length 3.54; leg I femur 3.74; F1/CL ratio 2.95. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 13A). Carapace very tall (CH/CL ratio 2.22); 1.27 long, 2.82 high, 1.18 wide, ‘neck’ 0.56 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of ‘head’ (ratio of HPC to post-ocular length 0.67), carapace steeply sloping and convex posterior to HPC; ‘head’ moderately elevated dorsally (post-ocular ratio 0.31). Chelicerae with dense, pick-like tuft of accessory setae on anterior face of paturon (Fig. 13B). Abdomen 1.69 long, 1.44 wide; almost spherical, with largely recumbent hump-like tubercles; dorsal scute fused anteriorly to epigastric sclerites. Un-expanded pedipalp (Figs 13C–E) of Type C morphology (Fig. 6), with retrolaterally directed, proximally constricted conductor and apple-shaped bulb profile in ventral view; embolus distally directed, slightly sinuous, without spur; tegular sclerite 3 (TS 3) large, flattened, with prominent, distally folded apex; TS 2-2a looped over retrolateral edge of conductor, TS 2 with strongly developed, spur-like apex extending to near distal rim of conductor, TS 2a looping around TS 3 proximally and projecting beyond distal rim of conductor to near tip of embolus; TS 1 indistinct, obscured by TS 2-3.

Female: Unknown.

Distribution and habitat. *Austrarchaea woodae* is known only from near the summit of Mount Bartle Frere, 12 km south-west of Babinda (Figs 22, 25). The only known specimen was collected in high altitude tropical rainforest.

Conservation status. Unknown (data deficient).

Remarks. See Remarks for *A. daviesae* (above).

***Austrarchaea hoskini* Rix & Harvey, sp. n.**

urn:lsid:zoobank.org:act:432C741C-00BA-4E9A-999C-8E0343C9F199

http://species-id.net/wiki/Austrarchaea_hoskini

Mount Elliot Assassin Spider

Figs 14, 23, 25

Austrarchaea sp. n. Rix and Harvey 2012b: 376, fig. 1G.

Type material. Holotype male: Mount Elliot, [Bowling Green Bay National Park], Upper North Creek, Queensland, Australia, [19°29'S, 146°57'E], rainforest, 1000 m, 2–5.XII.1986, G. Monteith, G. Thompson, S. Hamlet (QMB S30811).

Paratypes. Allotype female, Mount Elliot, [Bowling Green Bay National Park], North Creek, Queensland, Australia, 19°29'S, 146°57'E, 1000 m, 25–27.III.1991, G. Monteith, D. Cook (QMB S17937); 1 male, 1 female, same data (QMB S23045).

Other material examined. AUSTRALIA: **Queensland: Bowling Green Bay National Park:** same data as holotype, 1 juvenile (QMB S30811); same data as holotype except pitfall trap, 3–5.XII.1986, 1 juvenile (QMB S30839).

Etymology. The specific epithet is a patronym in honour of Dr Conrad Hoskin, for his contributions to our understanding of Wet Tropics biogeography, and for his efforts in documenting the remarkable endemic biota of Mount Elliot.

Diagnosis. *Austrarchaea hoskini* can be distinguished from all other Archaeidae from north-eastern Queensland by the presence of a unique Type D pedipalp (Fig. 6), with a prolaterally directed conductor (Figs 6, 14E), very large, dagger-shaped tegular sclerite 3 (TS 3) (Figs 6, 14E–F), and prominent, rounded, fin-shaped embolic spur (Fig. 14E).

Description. *Holotype male:* Total length 3.44; leg I femur 3.59; F1/CL ratio 2.86. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 14B). Carapace very tall (CH/CL ratio 2.29); 1.26 long, 2.87 high, 1.21 wide, 'neck' 0.59 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near posterior third of 'head' (ratio of HPC to post-ocular length 0.63), carapace almost horizontal posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.28). Chelicerae with short brush of accessory setae on anterior face of paturon (Fig. 14C). Abdomen 2.00 long, 1.54 wide; with two pairs of dorsal hump-like tubercles (HT 1–4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3–4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 14D–F) of Type D morphology (Fig. 6), with large, prolaterally directed, arched conductor; embolus distally directed, sinuous, with prominent, rounded, fin-shaped spur proximal to distal kink in embolus, embolus projecting beyond distal rim of conductor by $\sim 1/3$ length of exposed embolic portion; tegular sclerite 3 (TS 3) very large, dagger-like, directed pro-ventrally across bulb; TS 2–2a forming looped, figure-of-eight-shaped structure in ventral view, TS 2 rounded distally, TS 2a projecting beyond distal rim of conductor to near tip of embolus; TS 1 very small, indistinct, probably embedded within haematodochal membranes.

Allotype female: Total length 3.79; leg I femur 3.44; F1/CL ratio 2.44. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled grey-brown and beige (Fig. 14A). Carapace tall (CH/CL ratio 2.10); 1.41 long, 2.96 high, 1.31 wide; 'neck' 0.72 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) approaching posterior quarter of 'head' (ratio of HPC to post-ocular length 0.71), carapace almost horizontal anterior and slightly posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.29). Chelicerae without accessory setae on anterior face of paturon. Abdomen 2.31 long, 1.87 wide; with four pairs of dorsal hump-like tubercles (HT 1–4). Internal genitalia (Fig. 14G) with cluster of ~ 6 variably-shaped spermathecae on either side of gonopore, clusters widely separat-

ed along midline of genital plate; innermost (anterior) spermathecae longest, sausage-shaped, bent laterally; other spermathecae variably sausage-shaped or pyriform.

Variation: Males ($n = 2$): total length 3.38–3.44; carapace length 1.22–1.26; carapace height 2.78–2.87; CH/CL ratio 2.28–2.29. Females ($n = 2$): total length 3.59–3.79; carapace length 1.41 (invariable); carapace height 2.96–3.12; CH/CL ratio 2.10–2.21.

Distribution and habitat. *Austrarchaea hoskini* is known only from Mount Elliot, 30 km south-east of Townsville (Figs 23, 25). The few known specimens were collected in high altitude rainforest along North Creek.

Conservation status. Unknown (data deficient).

Austrarchaea spp. (unidentified specimens)

Note. In the absence of adult male specimens or molecular data, the following female and juvenile specimens (see Figs 16–23, 25) could not be confidently identified as known species. Species of *Austrarchaea* are difficult to identify (and diagnose) by females alone, and in the Wet Tropics these difficulties were compounded by the absence of representative adults from across the region. Material is thus here listed according to upland subregional zones of faunal endemism, as proposed for the Wet Tropics bioregion (see Discussion, below; Table 1; Figs 16B–23B).

Material examined. AUSTRALIA: Queensland: FINNIGAN UPLANDS: Monkhouse Timber Reserve: Moses Creek, 4 km NNE. of Mount Finnigan, 15°47'S, 145°17'E, berlesate, sieved rainforest litter, 14–16.X.1980, T. Weir, 1♀ (ANIC); Mount Boolbun South, 15°57'S, 145°08'E, 850–1000 m, 4–6.XI.1995, G. Monteith, D. Cook, L. Roberts, 1♀ (QMB S41070). **Cedar Bay National Park:** Mount Hartley, 15°47'S, 145°19'E, pyrethrum, trees & logs, 750 m, 8.XI.1995, G. Monteith, 1 juvenile (QMB). **THORNTON UPLANDS: Daintree National Park (Cape Tribulation Section):** Mount Sorrow Ridge Walk, centre saddle ~1.5 km from start, 16°04'35"S, 145°27'32"E, sifting elevated leaf litter under lawyer vine palms, tropical rainforest, 203 m, 20.III.2012, M. & A. Rix, 2♀, 1 juvenile (WAM T125629); same data, 1♀ (QMB S92211); on track to Mount Sorrow, 16°04'43"S, 145°27'42"E, day collecting, sifting leaf litter, mini-winklers, rainforest, 600 m, 20.IV.2009, H. Wood, 1♀ (CASENT 9028390); 4 km W. of Cape Tribulation (Site 8), 16°05'S, 145°26'E, QM berlesate, stick brushing, rainforest, 720 m, 29–30.IX.1982, G. Monteith, D. Yeates, G. Thompson, 1 juvenile (QMB S30802); 5 km W. of Cape Tribulation (Site 10), pyrethrum knockdown, rainforest, 780 m, 28.IX.1982, G. Monteith, D. Yeates, G. Thompson, 1 juvenile (QMB S30818); 4.5–5 km W. of Cape Tribulation (Top Camp), pyrethrum knockdown, rainforest, 760–780 m, 1–6.X.1982, G. Monteith, D. Yeates, G. Thompson, 1 juvenile (QMB S30825); Thornton Peak, via Daintree, 1100–1300 m, 24–27.IX.1984, G. & S. Monteith, 1 juvenile (QMB S30801). **Monkhouse Timber Reserve:** Mount Pieter Botte, 16°04'S, 145°24'E, pyrethrum, trees, logs,

rocks, 950 m, 21.XI.1983, G. Monteith, H. Janetzki, 1 juvenile (QMB). **CARBINE UPLANDS: Daintree National Park (Mossman Gorge Section):** Upper Whyanbeel Creek, 16°23'S, 145°17'E, pyrethrum, mossy rocks, 1150 m, 5.IX.1992, G. Monteith, 3 juveniles (QMB S38582). **Mount Lewis Forest Reserve:** Mount Lewis, summit, via Julatten, QM berlesate, stick brushings, rainforest, 1200 m, 10.IX.1981, G. Monteith, D. Cook, 1 juvenile (QMB S30841). **Mount Spurgeon Forest Reserve:** Mount Spurgeon, summit, 16°26'S, 145°12'E, 1320 m, 21.XI.1997, G. Monteith, D. Cook, C. Burwell, 1♀ (QMB S35869). **BLACK MOUNTAIN CORRIDOR: Mowbray National Park:** Black Mountain, 17 km ESE. of Julatten, pyrethrum knockdown, 800–1000 m, 29–30.IV.1982, G. Monteith, D. Yeates, D. Cook, 1 juvenile (QMB S30813). **LAMB UPLANDS: Danbulla National Park:** Mount Haig, 17°06'S, 145°36'E, pitfall trap, 1150 m, 4–31.V.1995, P. Zborowski, 1 juvenile (ANIC). **Dinden National Park:** Isley Hills, 17°03'S, 145°42'E, pyrethrum, trees and rocks, 1050 m, 30.XI.1993, G. Monteith, H. Janetzki, 1 juvenile (QMB S59692). **MALBON-THOMPSON UPLANDS: Russell River National Park:** Graham Range, 17°17'S, 145°58'E, pyrethrum, logs, 550 m, 8–9.XII.1995, G. Monteith, G. Thompson, D. Cook, 1♀ (QMB S37969); same data except pyrethrum, trees and logs, 1.XI.1995, G. Monteith, 2 juveniles (QMB). **BELLENDEN KER/BARTLE FRERE: Wooroonooran National Park:** Bellenden Ker Range, 0.5 km south of Cable Tower No. 7, pyrethrum knockdown on logs, stones and tree trunks, 500 m, 17–24.X.1981, Earthwatch, QM, 1 juvenile (QMB S30828); Massey Range, 17°16'S, 145°49'E, QM berlesate, sieved litter, rainforest, 1250 m, 10.X.1991, G. Monteith, H. Janetzki, 1 juvenile (QMB S49636). **ATHERTON UPLANDS: Herberton Range National Park:** Longlands Gap, 17°28'S, 145°29'E, pitfall trap, 1150 m, 4.II.–6.III.1995, P. Zborowski, 1 juvenile (ANIC). **Herberton Range State Forest:** Baldy Mountain Road, 7 km SW. Atherton, pyrethrum, logs & trees, 1150 m, 9.XII.1988, G. Monteith, G. Thompson, 1 juvenile (QMB). **Tully Gorge National Park:** Mount Tyson, 2 km W. of Tully, 17°55'S, 145°54'E, QM berlesate, sieved litter, rainforest, 650 m, 7.V.1983, D. Yeates, 1 juvenile (QMB S30800); Upper Boulder Creek, via Tully, 17°50'S, 145°54'E, QM berlesate, sieved litter, rainforest, 900 m, 27.X.1983, G. Monteith, D. Yeates, G. Thompson, 1 juvenile (QMB S30805); Upper Boulder Creek, 10 km N. of Tully, 800 m, 4–5.XII.1989, G. Monteith, G. Thompson, H. Janetzki, 1♀ (QMB S73924); Upper Boulder Creek, 11 km NNW. of Tully, 850 m, 16–19.XI.1984, D. Cook, G. Monteith, G. Thompson, 1♀ (QMB S30815); same data except pyrethrum, logs & trees, 1000 m, 5.XII.1989, G. Monteith, G. Thompson, H. Janetzki, 1 juvenile (QMB). **Wooroonooran National Park:** Hughes Road, Topaz, 17°26'S, 145°42'E, pitfall trap, 650 m, VII.–IX.1993, G. Monteith, S. Breeden, 1 juvenile (QMB S25715); “Palmerston National Park”, 17°35'30"S, 145°42'00"E, pitfall trap, rainforest, 670 m, 25.VII.–30.XI.1992, R. Raven, P. & E. Lawless, M. Shaw, 1 juvenile (QMB S21921). **KIRRAMA UPLANDS: Girringun National Park:** Cardwell Range, Upper Broadwater Creek Valley, pitfall trap, rainforest, 750 m, 18.XII.1986–14.I.1987, G. Monteith, G. Thompson, S. Hamlet, 1 juvenile (QMB S30842).

The Mackay-Whitsundays Hinterland fauna

Austrarchaea griswoldi Rix & Harvey, sp. n.

urn:lsid:zoobank.org:act:5E8091DF-D073-49CB-B6AC-9D730BC126A6

http://species-id.net/wiki/Austrarchaea_griswoldi

Eungella Assassin Spider

Figs 1A–D, 15, 24–25

Austrarchaea sp. n. '(NEQ-2)' Rix and Harvey 2012b: 379, figs 3, 6.

Type material. Holotype male: Eungella National Park (Broken River Section), Broken River Rainforest Discovery Circuit and Granite Bend Circuit, Queensland, Australia, 21°10'07"S, 148°30'22"E, sifting elevated leaf litter under palms (especially fan palms), tropical rainforest, 684 m, 23.III.2012, M. & A. Rix (QMB S92212).

Paratypes: Allotype female, same data as holotype (QMB S92213); 2 males, 1 female and 2 juveniles, same data as holotype (WAM T125630); 1 female, same data as holotype except Broken River Rainforest Discovery Circuit, hand collecting at night, 24.III.2012 (QMB S92214).

Other material examined. AUSTRALIA: *Queensland: Eungella National Park:* Broken River Rainforest Walk, 21°10'02"S, 148°30'23"E, litter, night collection, 720 m, 30.XI.2008, H. Smith, 1 juvenile (AMS KS106561); off Crediton Road Loop, 21°11'09"S, 148°31'43"E, sifting elevated leaf litter under fan palms, tropical rainforest, 673 m, 24.III.2012, M. & A. Rix, 1 juvenile (WAM T125631). *Eungella:* Schoolhouse rainforest general collection, 21°08'S, 148°29'E, 11–15.II.1986, R. Raven, J. Gallon, 1 juvenile (QMB S7039).

Etymology. The specific epithet is a patronym in honour of Dr Charles Griswold, for his outstanding contributions to arachnology, and for his contributions to the study of Archaeidae and other basal Araneomorphae.

Diagnosis. *Austrarchaea griswoldi* can be distinguished from all other Archaeidae from north-eastern Queensland by the presence of a unique Type E pedipalp (Fig. 6), with a very large bulb (width $\gg$ 0.30 mm) (Figs 6, 15E), modified ventro-distal rim of the tegulum forming rectangular opercular plate (Figs 6, 15E), and very large, flattened tegular sclerite 3 (TS 3), the latter extending along the entire retrolateral edge of the conductor (Fig. 15F). This species can be further distinguished by the very short, barely differentiated comb of accessory setae on the male chelicerae (Fig. 15C), and by the presence of only two pairs of female spermathecae (Fig. 15G).

Description. *Holotype male:* Total length 3.08; leg I femur 2.99; F1/CL ratio 2.62. Cephalothorax dark reddish-brown; legs dark tan-brown with darker annulations; abdomen mottled dark grey-brown and beige, with darker brown dorsal scute and sclerites (Fig. 15B). Carapace tall (CH/CL ratio 2.17); 1.14 long, 2.47 high, 1.11 wide, 'neck' 0.58 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near middle of 'head' (ratio of HPC to post-ocular length 0.56),

carapace sloping in straight plane posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.27). Chelicerae with very short, barely differentiated comb of accessory setae on anterior face of paturon (Fig. 15C). Abdomen 1.47 long, 1.05 wide; with two pairs of dorsal hump-like tubercles (HT 1-4); dorsal scute fused anteriorly to epigastric sclerites, extending posteriorly to first pair of hump-like tubercles; HT 3-4 each covered by separate dorsal sclerites. Unexpanded pedipalp (Figs 15D-F) of Type E morphology (Fig. 6), very large in size (width of bulb $\gg$ 0.30), with retrolaterally directed, arched conductor; ventro-distal rim of tegulum distally extended to form rectangular opercular plate; embolus distally directed, curved, without spur, projecting only slightly beyond distal rim of conductor; tegular sclerite 3 (TS 3) very large, flattened, extending along entire retrolateral edge of conductor; TS 2-2a largely obscured by rectangular opercular plate, TS 2a projecting beyond distal rim of conductor to just past tip of embolus; TS 1 deeply embedded in bulb, obscured by opercular plate, not visible in ventral view.

Allotype female: Total length 3.68; leg I femur 2.87; F1/CL ratio 2.29. Cephalothorax dark reddish-brown; legs tan-brown with darker annulations; abdomen mottled dark grey-brown and beige (Fig. 15A). Carapace tall (CH/CL ratio 2.20); 1.26 long, 2.77 high, 1.21 wide; 'neck' 0.70 wide; bearing two pairs of rudimentary horns; highest point of pars cephalica (HPC) near middle of 'head' (ratio of HPC to post-ocular length 0.55), carapace sloping in straight plane posterior to HPC; 'head' not strongly elevated dorsally (post-ocular ratio 0.28). Chelicerae without accessory setae on anterior face of paturon. Abdomen 1.92 long, 1.59 wide; with four pairs of dorsal hump-like tubercles (HT 1-4). Internal genitalia (Fig. 15G) with pair of pyriform spermathecae on either side of gonopore, clusters widely separated along midline of genital plate.

Variation: Males (n = 3): total length 2.87–3.08; carapace length 1.10–1.14; carapace height 2.37–2.51; CH/CL ratio 2.15–2.22. Females (n = 3): total length 3.03–3.68; carapace length 1.24–1.26; carapace height 2.72–2.77; CH/CL ratio 2.16–2.23.

Distribution and habitat. *Austrarchaea griswoldi* is known only from Eungella National Park, 70 km west of Mackay (Figs 24–25). Specimens have been collected by beating and sifting elevated leaf litter in tropical rainforest (Fig. 1E), especially under the dead fronds of Eungella Fan Palms (*Livistona* sp.).

Natural history. A single female specimen was collected by MGR during night collecting in March 2012, suspended with her egg-sac in a tangled maternal web decorated with hanging debris, at the base of a large standing rainforest tree trunk. This egg-sac (Fig. 1D) was carried with both legs IV, positioned behind and against the posterior face of the abdomen, and was composed of soft brown silk. The shape of the egg-sac was irregular, with two large projections, and 18 spiderlings hatched out of the egg-sac on 3–4 April 2012.

Conservation status. This species appears to be a short-range endemic taxon (Harvey 2002b, Harvey et al. 2011), which although potentially restricted in distribution, is abundant within the Eungella National Park (MGR, pers. obs.). It is not considered to be of conservation concern.

***Austrarchaea* spp. (unidentified specimens)**

Note. In the absence of adult male specimens or molecular data, the following female specimens (see Figs 24–25) could not be confidently identified as known species.

Material examined. **AUSTRALIA: Queensland: Dryander National Park:** Mount Dryander, [17 km WNW. of Airlie Beach], pyrethrum, 800 m, 21.XI.1992, G. Monteith, G. Thompson, H. Janetzki, 1♀ (QMB S49380). **Eungella National Park:** Finch Hatton [Gorge], sweeping, complex notophyll vine forest (CNVF), 7–14. IV.1975, R. Kitching, V. Davies, 1♀, 1 juvenile (QMB S1093).

Discussion

The Wet Tropics World Heritage Area. The Australian Wet Tropics bioregion, situated in north-eastern Queensland between Cooktown and Townsville (Figs 16–23, 25), is a World Heritage area renowned for its rich rainforest biota and very high levels of local endemism (e.g. see Williams et al. 1996, Crisp et al. 2001, Yeates et al. 2002, Slatyer et al. 2007, and references therein). Much has been written about the biogeography of the region, and numerous seminal contributions over several decades have resulted in the Wet Tropics becoming a model landscape for understanding processes of rainforest biogeography, speciation and diversification, in both plant and animal taxa (e.g. Williams et al. 1996, Schneider et al. 1998, Moritz et al. 2000, Crisp et al. 2001, Yeates et al. 2002). Much of this research has focussed on Pleistocene climatic fluctuations, and the concomitant effects these fluctuations have had on the vicariant biogeography, phylogeography and/or speciation of different taxa, especially vertebrates (e.g. Schneider et al. 1998, Schneider and Moritz 1999, Hoskin et al. 2011, Bell et al. 2012). However, as highlighted by Hoskin et al. (2011), few vertebrate lineages have undergone *in situ* radiation within the Wet Tropics, and most show little phenotypic divergence despite often strong phylogeographic signal; evidence for a deeper and more complex history of speciation. Different taxa also highlight a variety of responses and wildly different patterns of distribution and endemism at different spatial scales (Hoskin et al. 2011), and this is especially true of invertebrates, which often show “extraordinarily high” levels of diversity and endemism compared to vertebrates (Bell et al. 2007: 4995; see also Yeates et al. 2002). Indeed, for flightless or low vagility arthropods, the Wet Tropics have aptly been described as an “epicentre of evolution” (Bouchard 2002: 449), and much remains to be tested in order to understand historical mechanisms of speciation (and subsequent extinction, range contraction or dispersal) in both space and time. Allopatric speciation within Pliocene or Pleistocene refugia has been suggested for at least several endemic insect and vertebrate lineages (e.g. Bell et al. 2007, Hoskin et al. 2011), although deeper, Miocene-age divergences are increasingly being implicated in the major diversification of the Australian Wet Tropics fauna (see Moritz et al. 2000).

Patterns of distribution within the Wet Tropics have historically been assessed in terms of ‘regional endemism’ (i.e. those species confined to the Wet Tropics) versus

‘subregional endemism’ (i.e. those species confined to a single subregion within the Wet Tropics) (Yeates et al. 2002), and an extensive subregional classification has been developed and modified for the entire Wet Tropics over nearly 30 years (e.g. see Winter et al. 1984, Monteith 1995, Williams et al. 1996, Schneider et al. 1998, Moritz et al. 2001, Edward 2011) (Table 1; Figs 16B–23B). This subregional classification, separating adjacent upland and lowland forest blocks, has provided a useful foundation for assessing patterns of distribution, diversity and endemism throughout the Wet Tropics, and has been widely tested or applied in studies of vertebrates (Williams et al. 1996, Schneider et al. 1998, Schneider and Moritz 1999, Dolman and Moritz 2006, Hoskin et al. 2011, Bell et al. 2012) and invertebrates (e.g. Bouchard 2002, Yeates et al. 2002, Bell et al. 2007, Edward 2011, Boyer and Reuter 2012). These studies include comparative analyses of endemism, biogeographical concordance and conservation significance within and between subregions (e.g. Moritz et al. 2001, Yeates et al. 2002), as well as more traditional estimates of phylogeny, biogeography and phylogeography across a suite of co-occurring taxa. For all such analyses, the historical biogeographic significance of the major upland subregions has been consistently demonstrated, with often strong concordance between palaeoclimatic modelling and phylogeographic structure (Yeates et al. 2002, Hoskin et al. 2011).

Archaeidae in the Wet Tropics. Assassin spiders appear to be largely ubiquitous in upland rainforests throughout most of the Wet Tropics, extending from the Finnigan Uplands near Cooktown south to the Elliot Uplands near Townsville (Fig. 25). Ar-

Table 1. List of upland subregional zones of faunal endemism identified for the Wet Tropics bioregion (by Winter et al. 1984, Williams et al. 1996 and other authors) (see Discussion; Figs 16B–23B), noting current collection records of Archaeidae, including the presence of any described species. Subregional zones are listed from the northern-most Mt Finnigan Uplands (Fig. 16B) to the southern-most Elliot Uplands (Fig. 23B). Note the addition of Hinchinbrook Island (as per Edward 2011), and the current absence of archaeid collections from four of the southern subregions. F = female specimen/s; J = juvenile specimen/s; M = male specimen/s; N.R. = no recorded specimens.

Wet Tropics Upland Subregion	Archaeidae	Described species
Mt Finnigan Uplands (FU)	Yes ^{M,F,J}	<i>A. wallacei</i>
Thornton Uplands (TU)	Yes ^{F,J}	
Windsor Uplands (WU)	Yes ^M	<i>A. karenae</i>
Carbine Uplands (CU)	Yes ^{M,F,J}	<i>A. tealei</i> , <i>A. thompsoni</i>
Black Mountain Corridor (BM)	Yes ^J	
Lamb Uplands (LU)	Yes ^{M,J}	<i>A. westi</i>
Malbon-Thompson Uplands (MT)	Yes ^{F,J}	
Bellenden Ker/Bartle Frere (BK)	Yes ^{M,F,J}	<i>A. daviesae</i> , <i>A. woodae</i>
Atherton Uplands (AU)	Yes ^{M,F,J}	<i>A. daviesae</i>
Kirrama Uplands (KU)	Yes ^J	
Hinchinbrook Island (HI)	N.R.	
Lee Uplands (LE)	N.R.	
Spec Uplands (SU)	N.R.	
Halifax Uplands (HU)	N.R.	
Elliot Uplands (EU)	Yes ^{M,F,J}	<i>A. hoskini</i>

chaeidae seem to be less common in lowland tropical rainforests (true of most species of *Austrarchaea* throughout their range), however populations from Mossman Gorge and near Cape Tribulation in the northern Daintree National Park suggest that they may be more widespread in lowland forest systems than current collection records suggest. Indeed, given the relatively high proportion of sites represented only by juvenile specimens or unidentified females (Fig. 25), the tendency for short-range endemism in *Austrarchaea* generally, and the very small number of adult male specimens available for taxonomic research, the Wet Tropics may actually be home to a significantly larger number of archaeid species than documented in this revision. For example, sites like Mount Bartle Frere support two sympatric or at least partially sympatric species (Figs 16, 22), and in the Mossman River region of the southern Daintree National Park, different taxa appear to occupy different lowland (*A. tealei*) versus upland (*A. thompsoni*) habitats in relatively close proximity (Figs 19–20). Apart from *A. daviesae*, which is known from two adjacent subregions (Fig. 16B), all of the other seven species of *Austrarchaea* described from the Wet Tropics are subregional endemics, from the Finnigan Uplands (*A. wallacei*), Windsor Uplands (*A. karenae*), Carbine Uplands (*A. tealei*, *A. thompsoni*), Lamb Uplands (*A. westi*) and the Bellenden Ker/Bartle Frere Uplands (*A. woodae*), respectively (see Table 1).

Estimating the actual number of Archaeidae in north-eastern Queensland is a difficult task, given the surprisingly small number of collection records for the region, the very small number of adult male specimens available, and the related absence in all but two instances of anything other than single-point distributions for most known species (Fig. 25). However, available records do provide some tantalising clues, and hint at the likelihood of a possible hotspot of archaeid diversity in the Wet Tropics. Indeed, with (i) at least four other upland subregional zones with known archaeid records but for which adult male specimens are unavailable, (ii) four additional upland subregions which may harbour archaeid populations but are currently without collections (Table 1), (iii) the likelihood that at least a minority of Wet Tropical subregions may harbour multiple endemic species, either sympatrically or in upland versus lowland habitats, and (iv) the likely presence of at least one additional species in a separate upland zone of the Whitsundays region (Fig. 24), the actual number of taxa in the *A. daviesae* species-group is almost certainly > 50% larger than currently recognised. Thus, at a conservative estimate, there may be 15 or more short-range endemic species in tropical Queensland, a number almost equivalent to the total archaeid diversity of mid-eastern Australia. These figures are perhaps not surprising, given the remarkable levels of diversity and endemism seen in other invertebrate groups (see Yeates et al. 2002), but raise the question of how (and when) this diversity was generated. Rix and Harvey (2012b) inferred an Eocene divergence date for taxa in the *A. daviesae* species-group (relative to mid-eastern Australian *Austrarchaea*), suggesting that the monophyletic archaeid fauna of north-eastern Queensland has evolved in isolation for 35–50 million years – a result at least consistent with the high levels of interspecific genitalic variation seen across this lineage relative to other Australian clades (Fig. 6). However, geographic sampling for both molecules and morphology is currently inadequate across the Wet Tropics, and a

more detailed, thoroughly-sampled molecular study is required to properly assess patterns of speciation in the *A. daviesae* species-group, and address the significant gaps in our understanding of divergence dates, distributional boundaries and inter-specific relationships within this lineage. The group's diversity, strict reliance on rainforest habitats and relative ubiquity in the Wet Tropics certainly makes them an ideal candidate for testing patterns of speciation and biogeography throughout the region, and it is our hope that this revision will provide a solid taxonomic foundation for future research.

Acknowledgements

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Figures

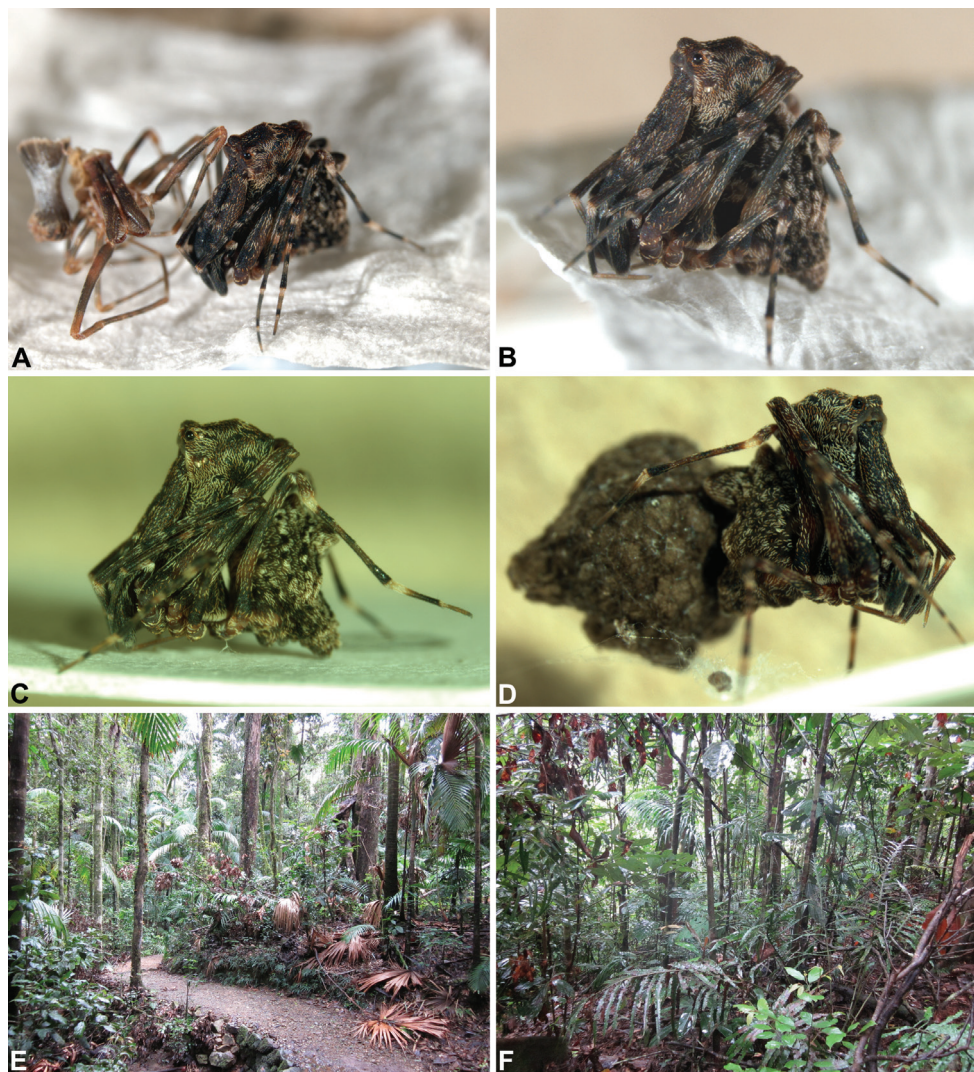


Figure 1. Habitus and habitat images of species Archaeidae from north-eastern Queensland. **A–D**, Habitus images of live paratype specimens of *Austrarchaea griswoldi* sp. n. from Eungella National Park: **A** newly-moulted female with recently cast cuticle; **B–C**, female, lateral view; **D**, female carrying egg-sac. **E–F**, Habitat images: **E**, tropical rainforest at Broken River, Eungella National Park – type locality of *A. griswoldi* sp. n.; **F**, dense tropical rainforest at Malaan National Park, Atherton Tableland – locality of *A. daviesae* Forster & Platnick.

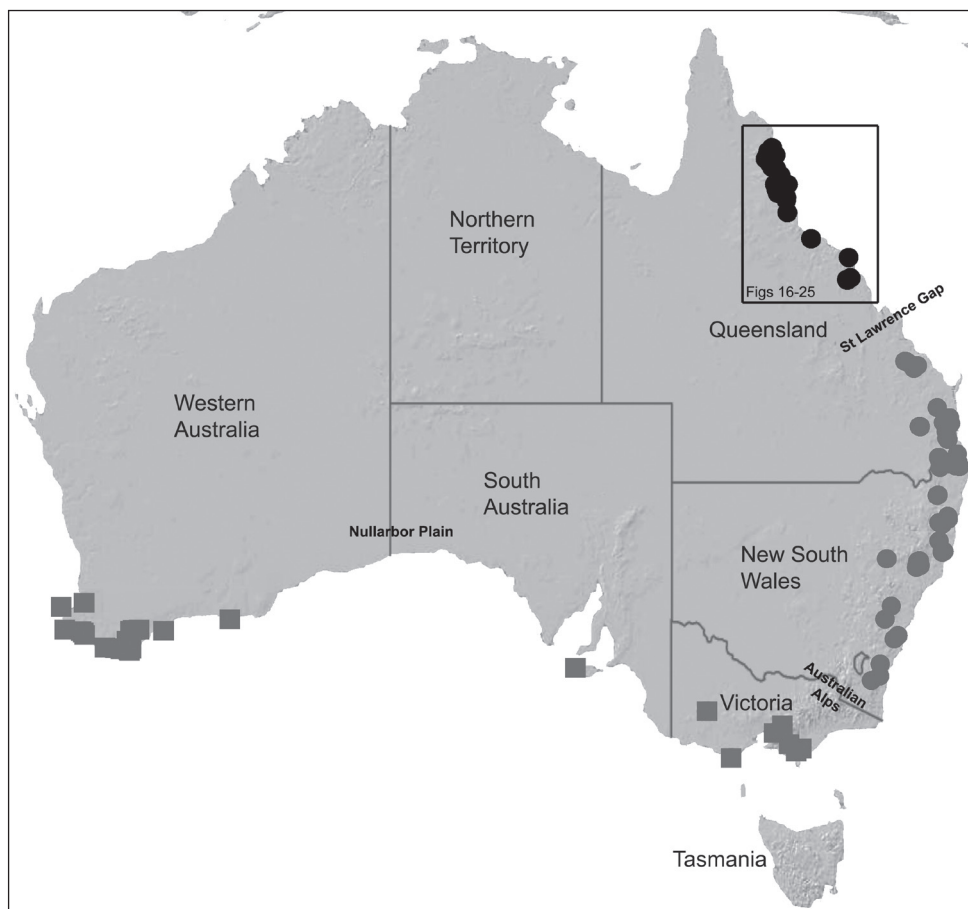


Figure 2. Map showing the known distribution of Archaeidae in Australia (circles for the genus *Austrarchaea*; squares for *Zephyrarchaea*), with locality records for north-eastern Queensland species of *Austrarchaea* in the *A. daviesae* species-group highlighted in black. Note the three major biogeographic and phylogenetic disjunctions in the distribution of Australian Archaeidae (see Rix and Harvey 2012b), especially the St Lawrence Gap, separating mid-eastern Australian taxa in the *Austrarchaea nodosa* species-group (see Figs 3–4).

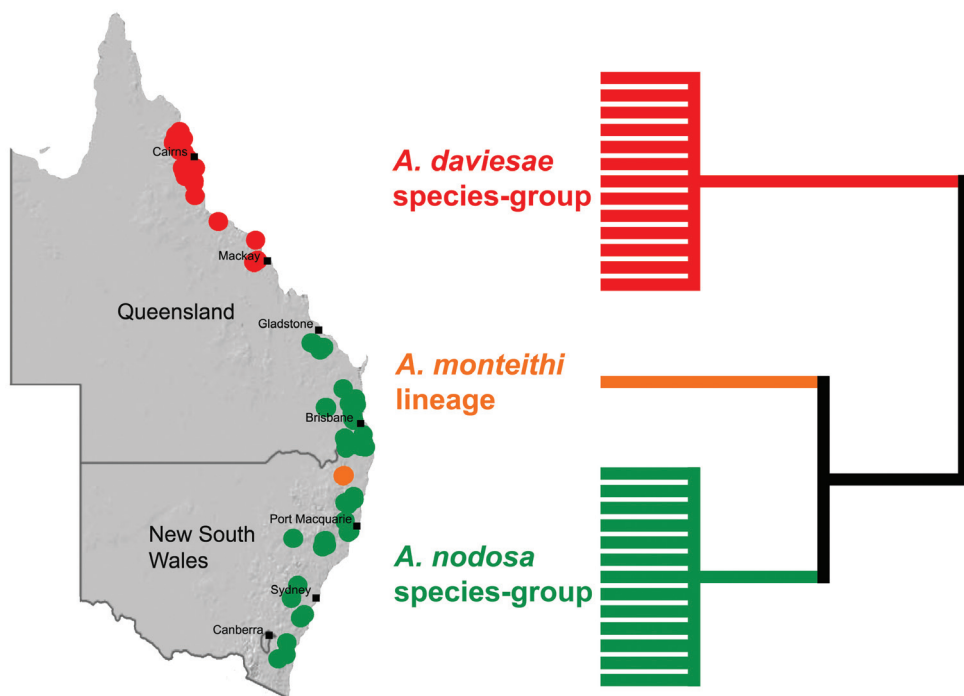


Figure 3. Distribution and phylogeny of *Austrarchaea* species from Rix and Harvey (2011, 2012b), showing the interrelationships of the three lineages from north-eastern Queensland (*A. daviesae* species-group), mid-eastern Australia (*A. nodosa* species-group) and the Gibraltar Range (*A. monteithi* lineage), respectively. See Figure 4 for a comparison of morphological differences between these three clades.

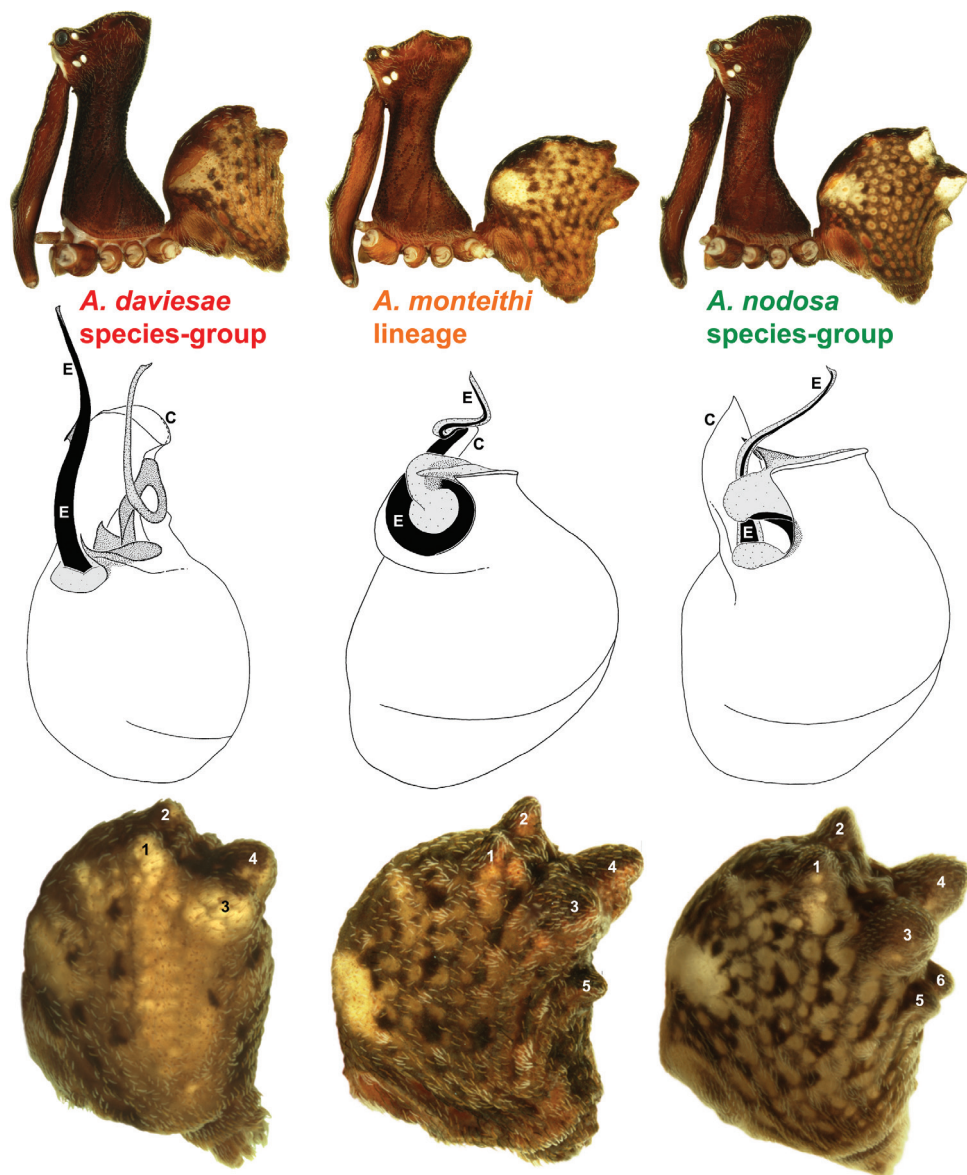


Figure 4. Morphological differences between the three lineages of *Austrarchaea* (see Fig. 3). Note the variation in the shape of the male pedipalp and the marked differences in the shape and orientation of the conductor (C), embolus (E) and the distal tegular sclerites. Note also the number of abdominal hump-like tubercles (1-6): four in the *A. daviesae* species-group; five in *A. monteithi*; and six in the *A. nodosa* species-group.

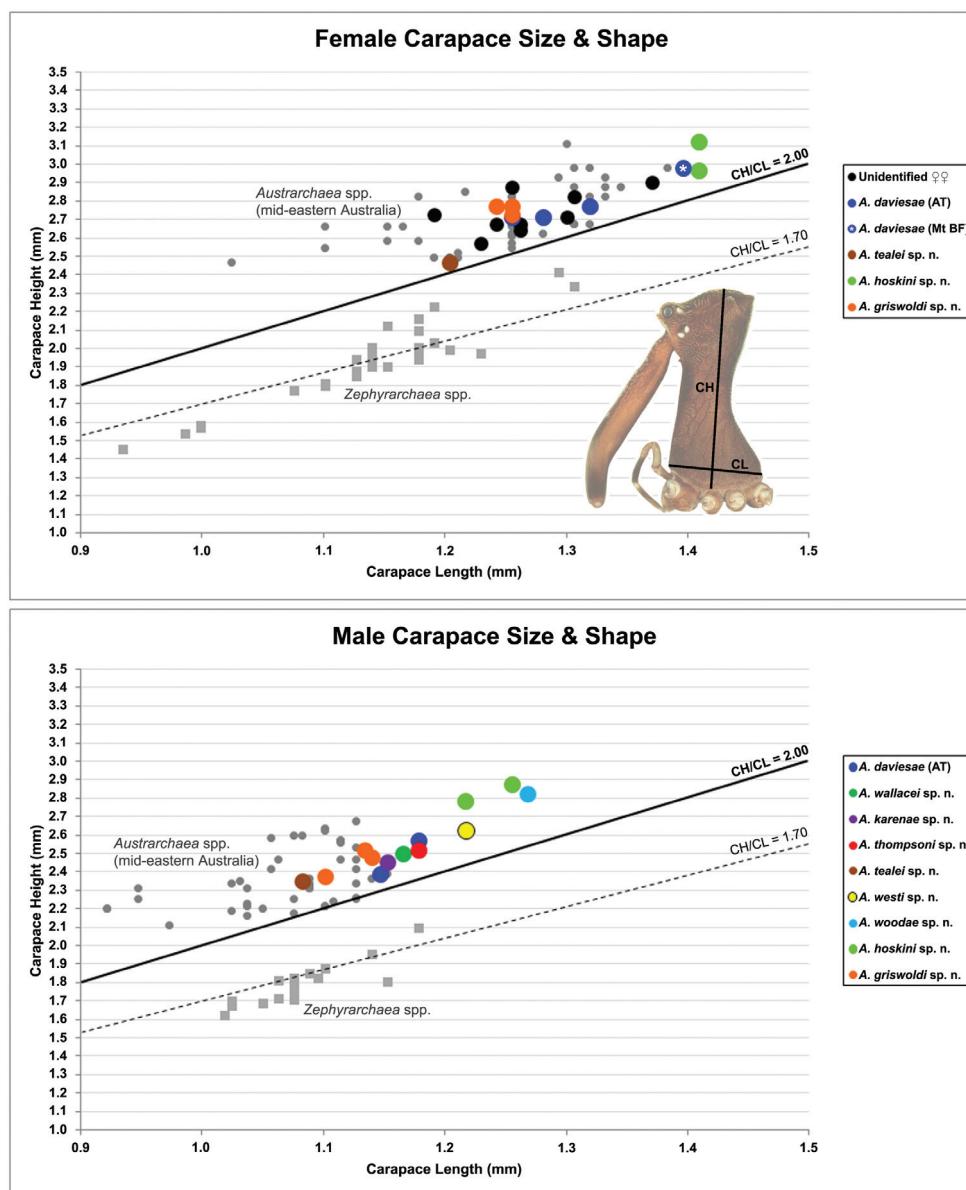


Figure 5. Graphs depicting the relationship between carapace length (CL) and carapace height (CH) for species of *Austrarchaea* from north-eastern Queensland. Smaller grey dots denote species of *Austrarchaea* from mid-eastern Australia (see Rix and Harvey 2011); smaller grey squares denote species of *Zephyrarchaea* from southern Australia (see Rix and Harvey 2012a). Note the relatively large body sizes of *A. hoskini* sp. n. and *A. woodae* sp. n., and the body size variation between populations of *A. daviesae* from the Atherton Tableland (AT) and Mount Bartle Frere (Mt BF), respectively.

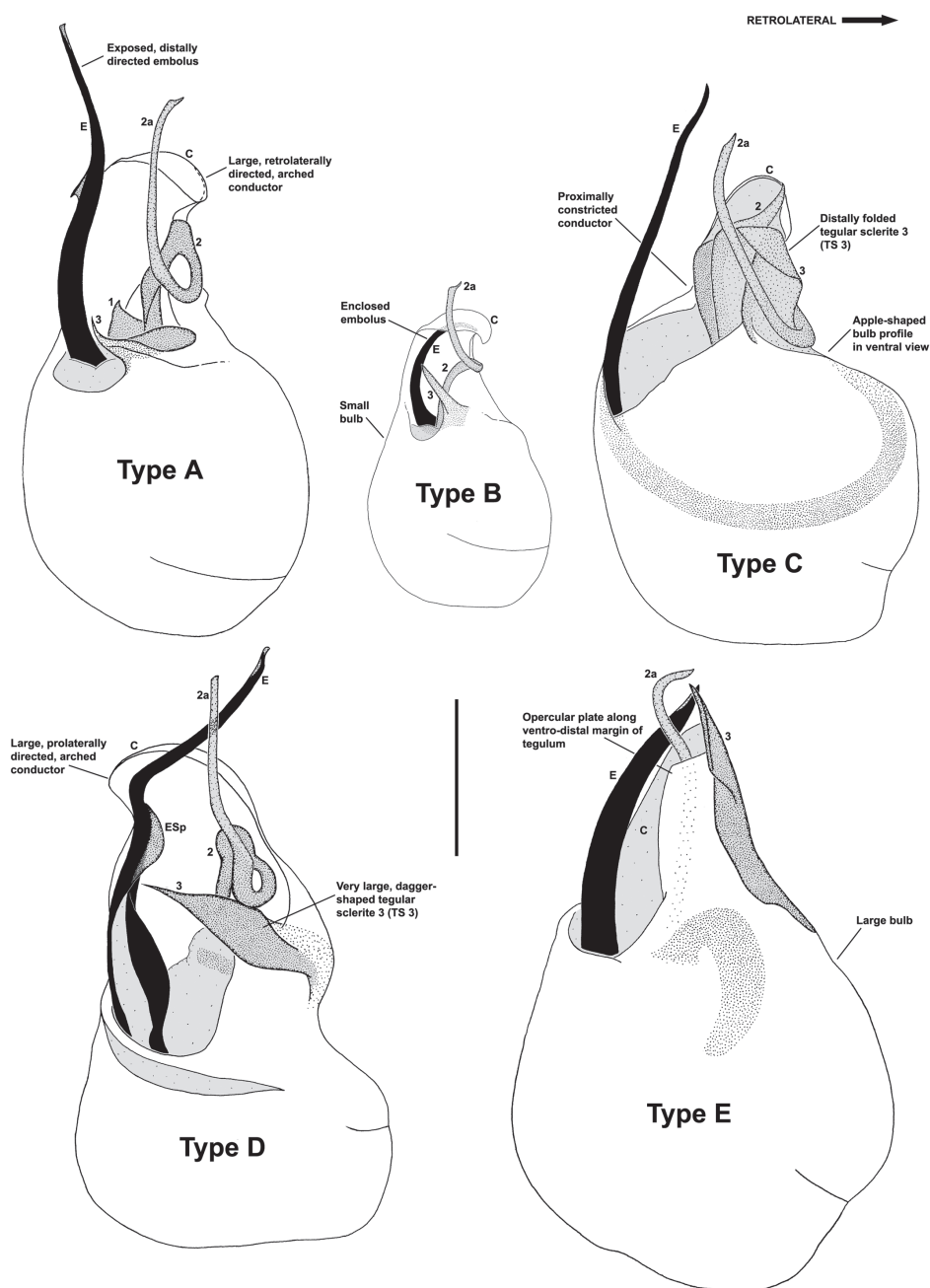


Figure 6. Morphological differences between the five pedipalp types (Types A–E) identified for species of *Austrarchaea* from north-eastern Queensland, with left bulbs illustrated in ventral view at scale-identical sizes. Type A pedipalps are shared among at least five species from the Wet Tropics bioregion; Types B–E are autapomorphic for single species. Note especially the variation in the size and shape of the bulb, and the shape and orientation of the conductor. C = conductor; E = embolus; ESp = embolic spur; (TS) 1–3 = regular sclerites 1–3. Scale bar = 0.2 mm.

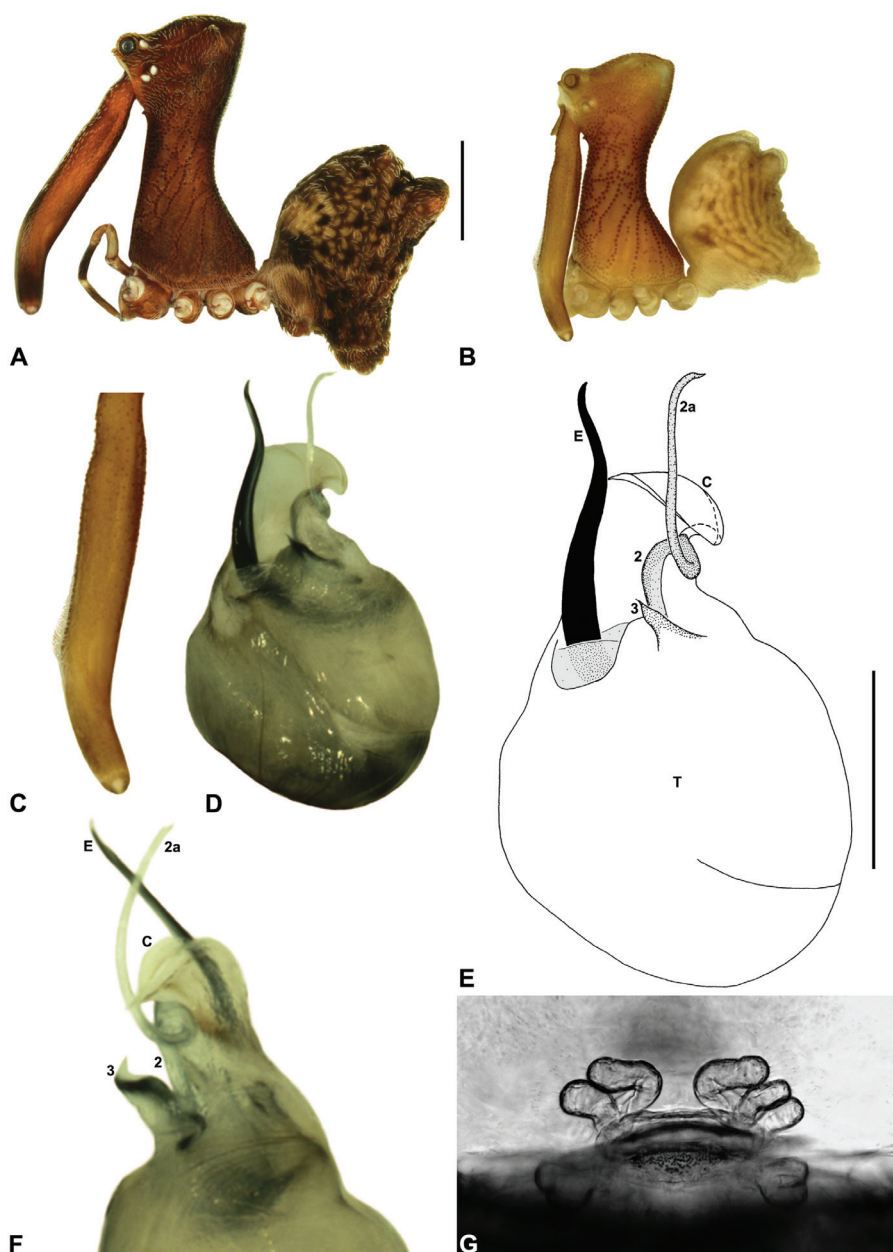


Figure 7. *Austrarchaea daviesae* Forster & Platnick, 1984. **A–B**, Cephalothorax and abdomen, lateral view: **A**, female (WAM T125183) from Malaan National Park, Atherton Tableland, NE. Queensland; **B**, holotype male (QMB S1091) from Majors Mountain, Atherton Tableland, NE. Queensland. **C**, Holotype male chelicerae, lateral view, showing accessory setae. **D–F**, Male (WAM T125183; from Malaan National Park, Atherton Tableland, NE. Queensland) pedipalp: **D–E**, bulb, ventral view; **F**, detail of distal regular sclerites, retrolateral view. **G**, Female (WAM T125183) internal genitalia, postero-ventral view (genital plate removed). C = conductor; E = embolus; T = tegulum; (TS)2–3 = regular sclerites 2–3. Scale bars: A–B = 1.0 mm; E = 0.2 mm.

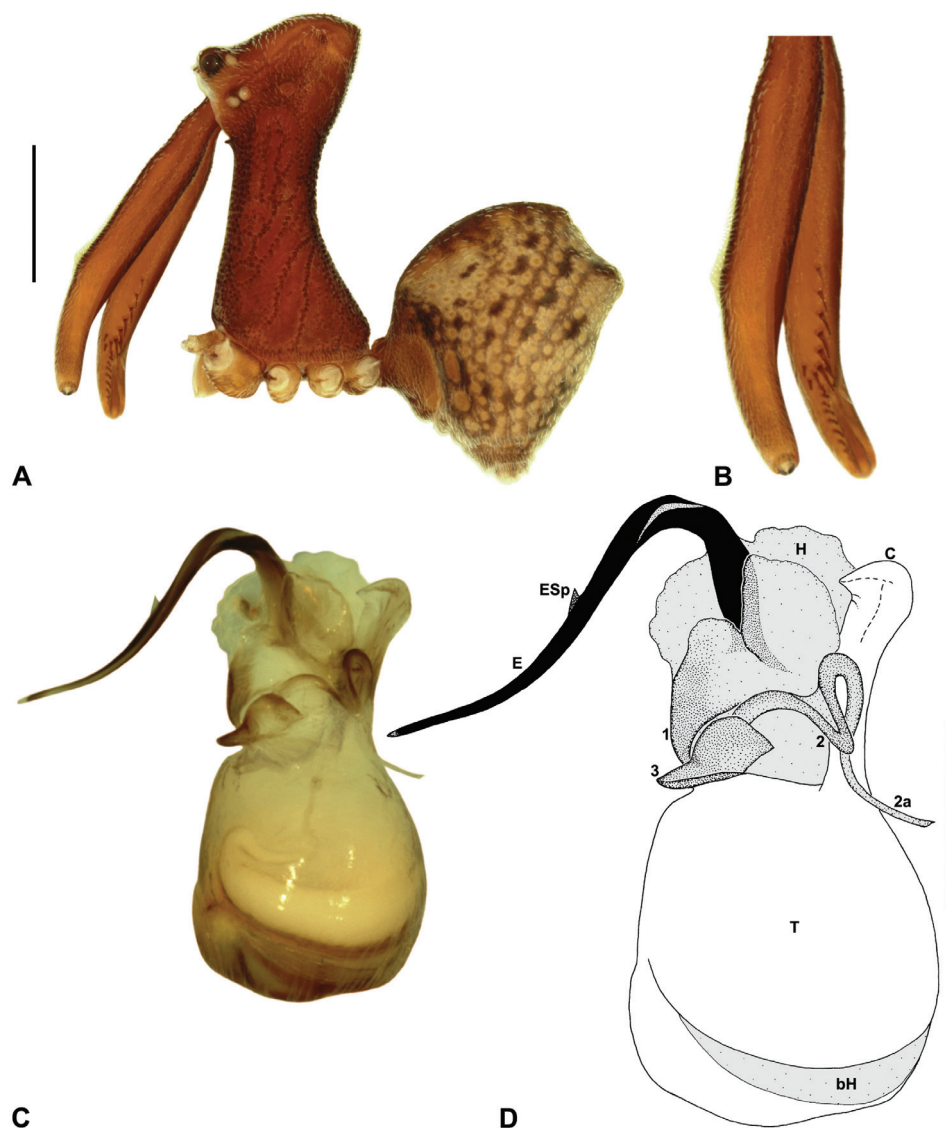


Figure 8. *Austrarchaea wallacei* sp. n. **A–D**, Holotype male (QMB S25964) from Mount Misery, Monkhouse Timber Reserve, NE. Queensland: **A**, cephalothorax and abdomen, lateral view; **B**, chelicerae, lateral view, showing accessory setae; **C–D**, right pedipalpal bulb (expanded; flipped horizontal for inter-specific comparison), retrolateral view. bH = basal haematodocha; C = conductor; E = embolus; ES_p = embolic spur; H = haematodocha; T = tegulum; (TS)1-3 = tegular sclerites 1-3. Scale bars: A = 1.0 mm; D = 0.2 mm.

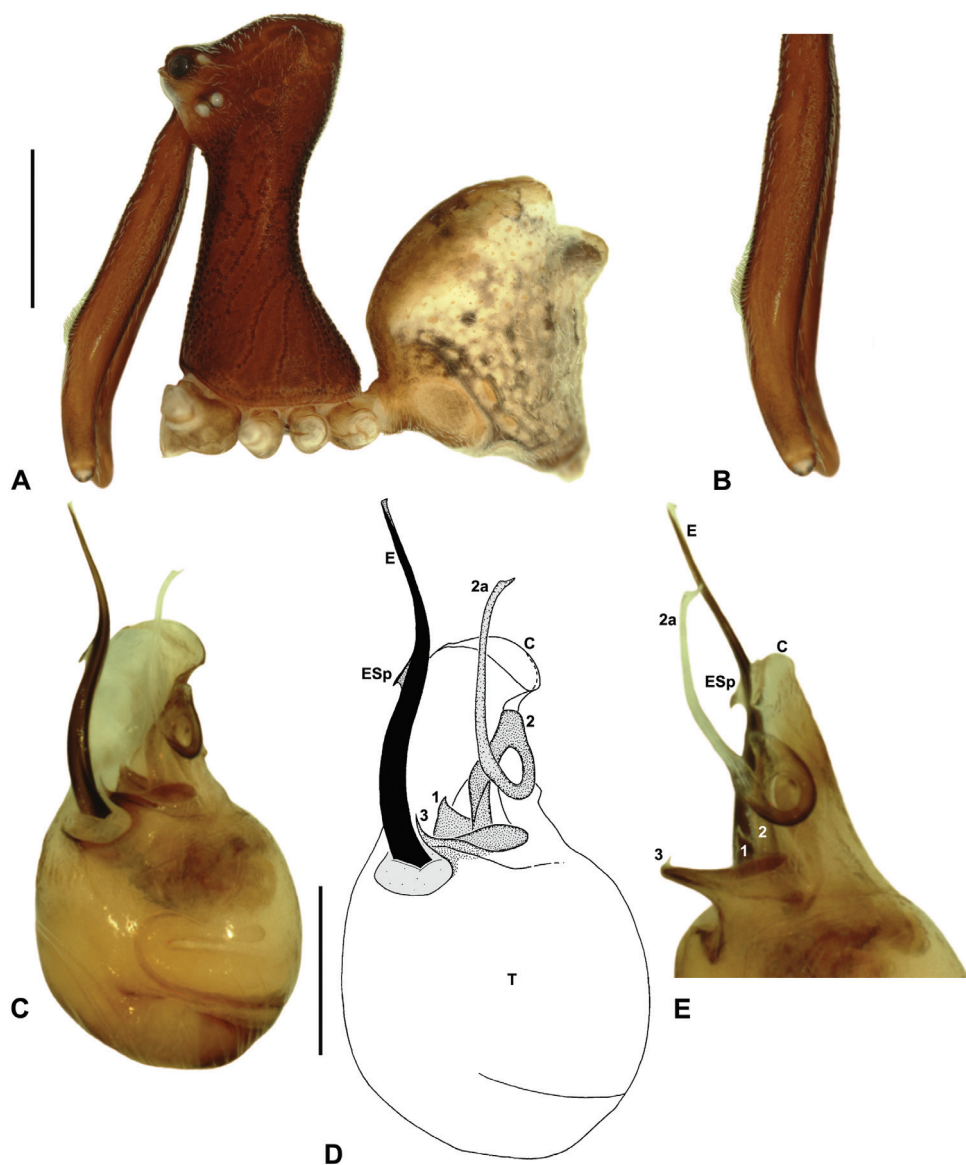


Figure 9. *Austrarchaea karenae* sp. n. **A–E**, Holotype male (QMB S43060) from Windsor Tableland, Windsor Tableland National Park, NE. Queensland: **A**, cephalothorax and abdomen, lateral view; **B**, chelicerae, lateral view, showing accessory setae; **C–D**, pedipalpal bulb, ventral view; **E**, detail of distal regular sclerites, retrolateral view. C = conductor; E = embolus; ES = embolic spur; T = tegulum; (TS)1-3 = regular sclerites 1-3. Scale bars: A = 1.0 mm; D = 0.2 mm.

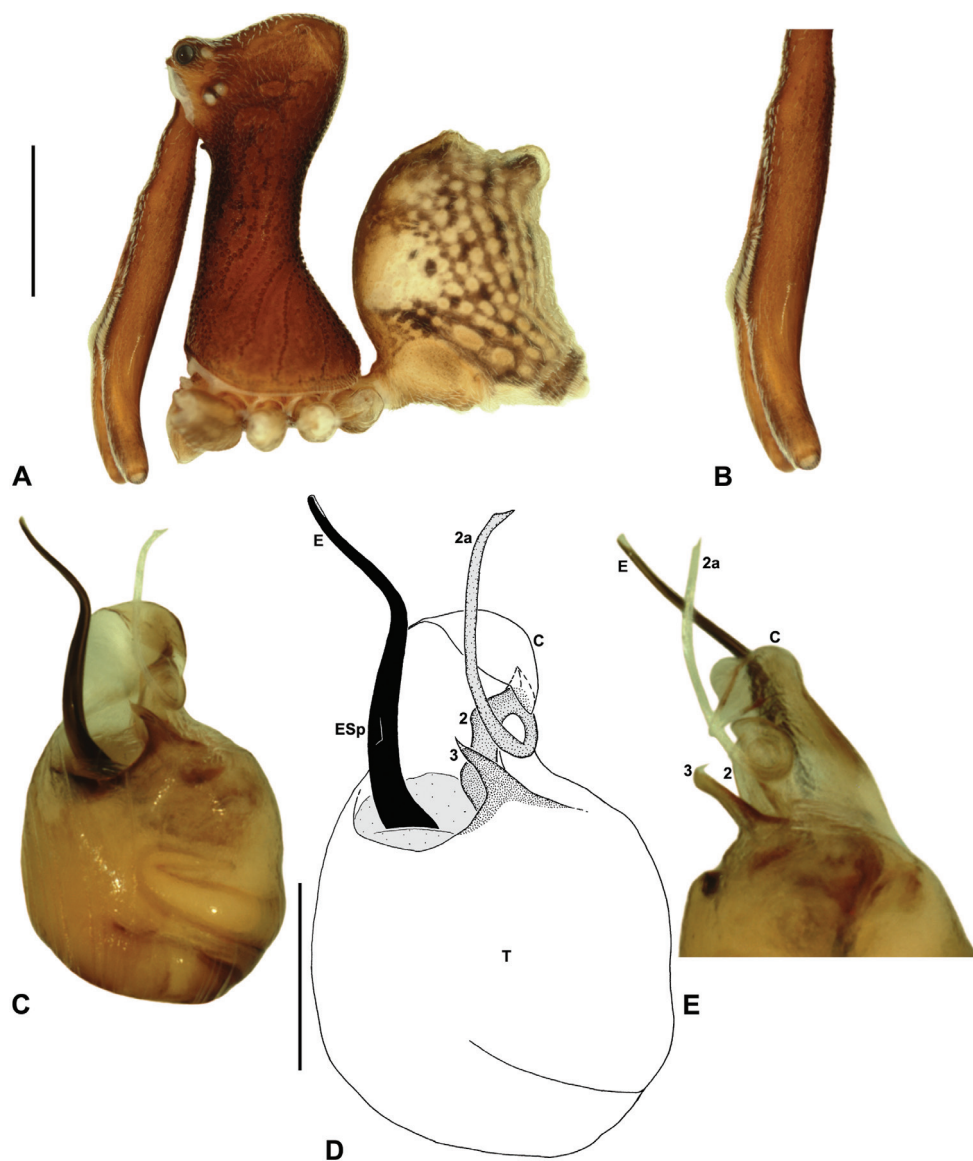


Figure 10. *Austrarchaea thompsoni* sp. n. **A–E**, Holotype male (QMB S30840) from Devils Thumb, Daintree National Park, NE. Queensland: **A**, cephalothorax and abdomen, lateral view; **B**, chelicerae, lateral view, showing accessory setae; **C–D**, pedipalpal bulb, ventral view; **E**, detail of distal tegular sclerites, retrolateral view. C = conductor; E = embolus; ES = embolic spur; T = tegulum; (TS)2-3 = tegular sclerites 2-3. Scale bars: A = 1.0 mm; D = 0.2 mm.

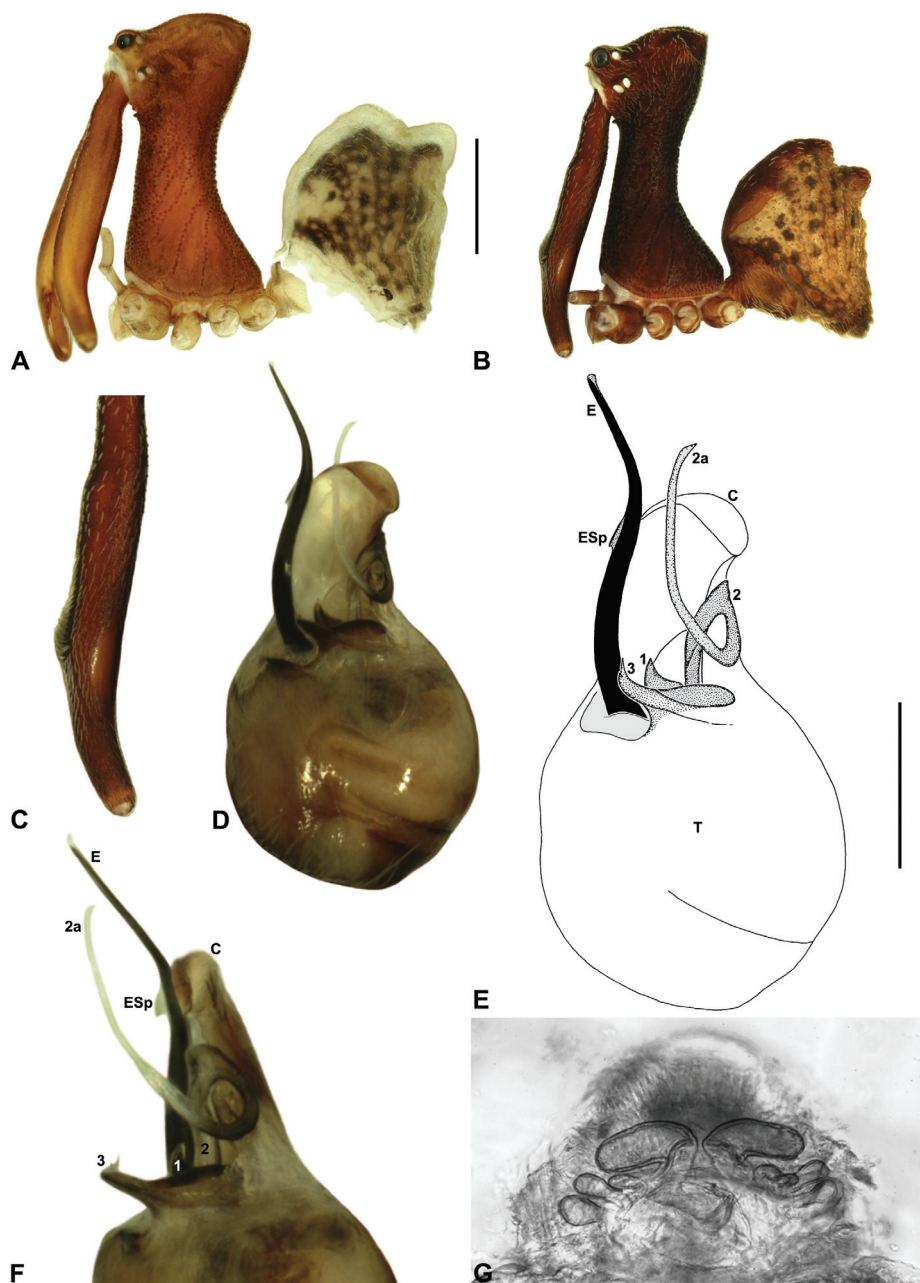


Figure 11. *Austrarchaea tealei* sp. n. **A–B**, Cephalothorax and abdomen, lateral view: **A**, female (ANIC) from Mossman Gorge, Daintree National Park, NE. Queensland; **B**, holotype male (QMB S92210) from Mossman Gorge, Daintree National Park, NE. Queensland. **C**, Holotype male chelicerae, lateral view, showing accessory setae. **D–F**, Holotype male pedipalp: **D–E**, bulb, ventral view; **F**, detail of distal regular sclerites, retrolateral view. **G**, Female (ANIC) internal genitalia, postero-ventral view (genital plate removed). C = conductor; E = embolus; ES = embolic spur; T = tegulum; (TS)1–3 = regular sclerites 1–3. Scale bars: A–B = 1.0 mm; E = 0.2 mm.

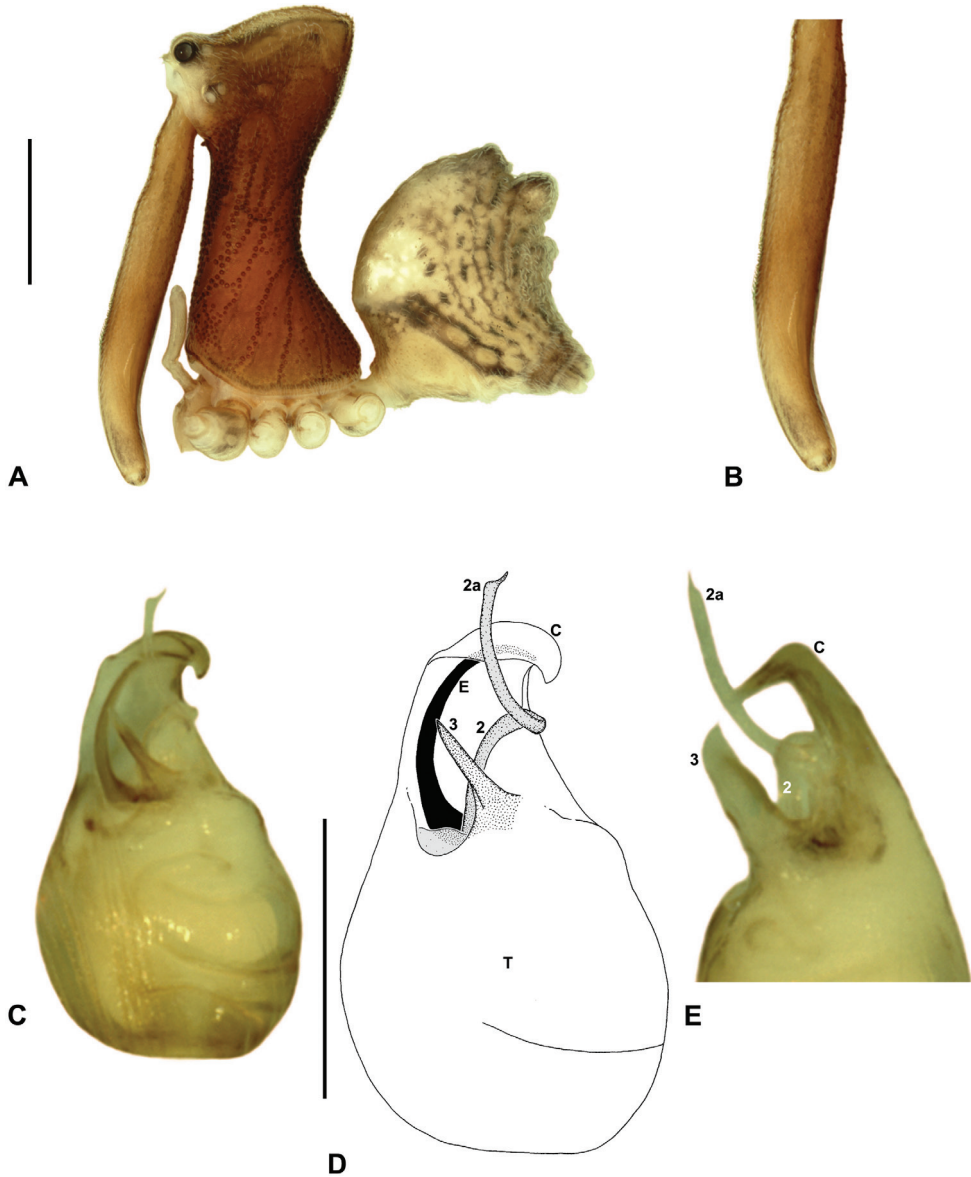


Figure 12. *Austrarchaea westi* sp. n. **A–E**, Holotype male (QMB S59537) from Mount Williams, Dinden National Park, NE, Queensland: **A**, cephalothorax and abdomen, lateral view; **B**, chelicerae, lateral view, showing lack of defined accessory setae; **C–D**, pedipalpal bulb, ventral view; **E**, detail of distal regular sclerites, retrolateral view. C = conductor; E = embolus; T = tegulum; (TS)2–3 = tegular sclerites 2–3. Scale bars: A = 1.0 mm; D = 0.2 mm.

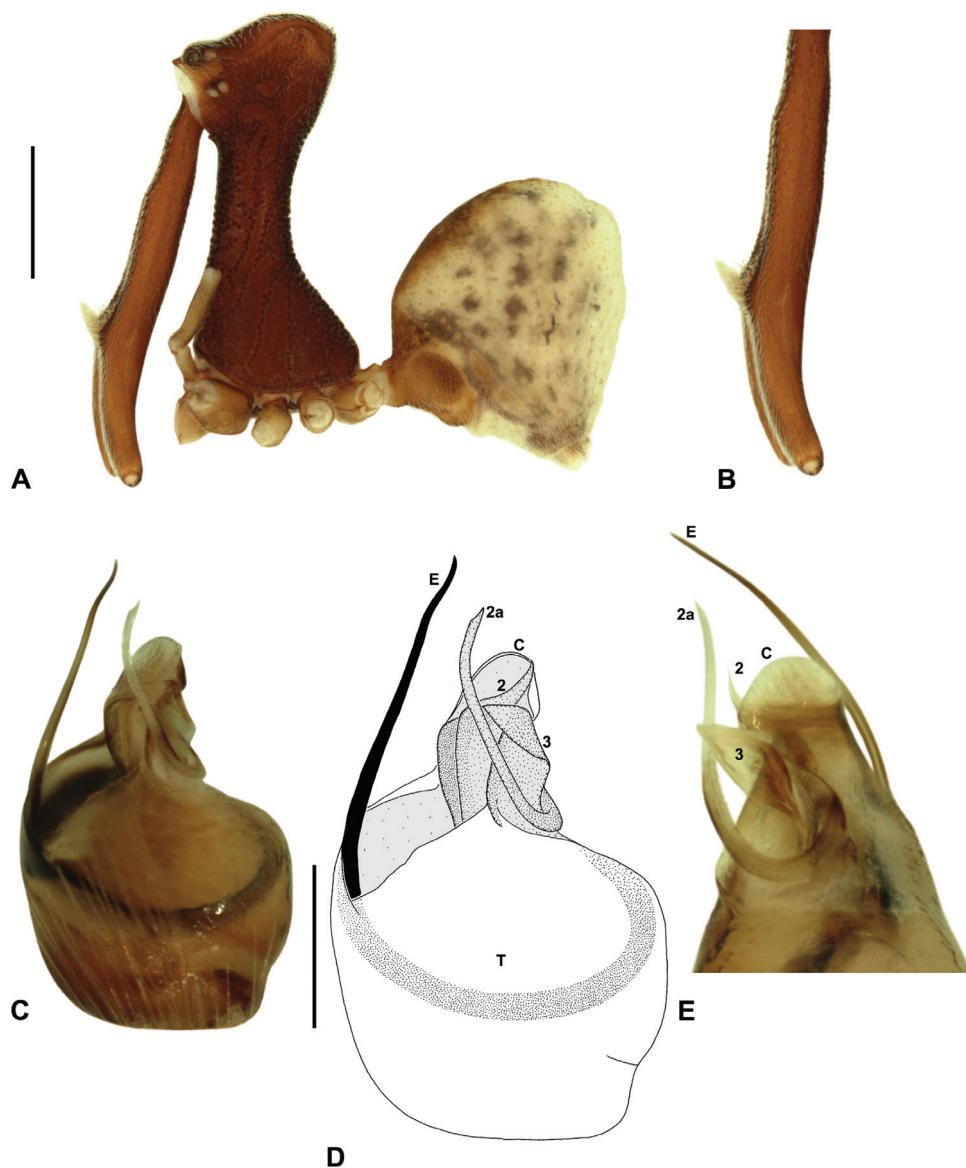


Figure 13. *Austrarchaea woodae* sp. n. **A–E**, Holotype male (QMB S72988) from Boulder Caves, Mount Bartle Frere, Wooroonooran National Park, NE. Queensland: **A**, cephalothorax and abdomen, lateral view; **B**, chelicerae, lateral view, showing accessory setae; **C–D**, pedipalpal bulb, ventral view; **E**, detail of distal tegular sclerites, retrolateral view. C = conductor; E = embolus; T = tegulum; (TS)2-3 = regular sclerites 2-3. Scale bars: A = 1.0 mm; D = 0.2 mm.

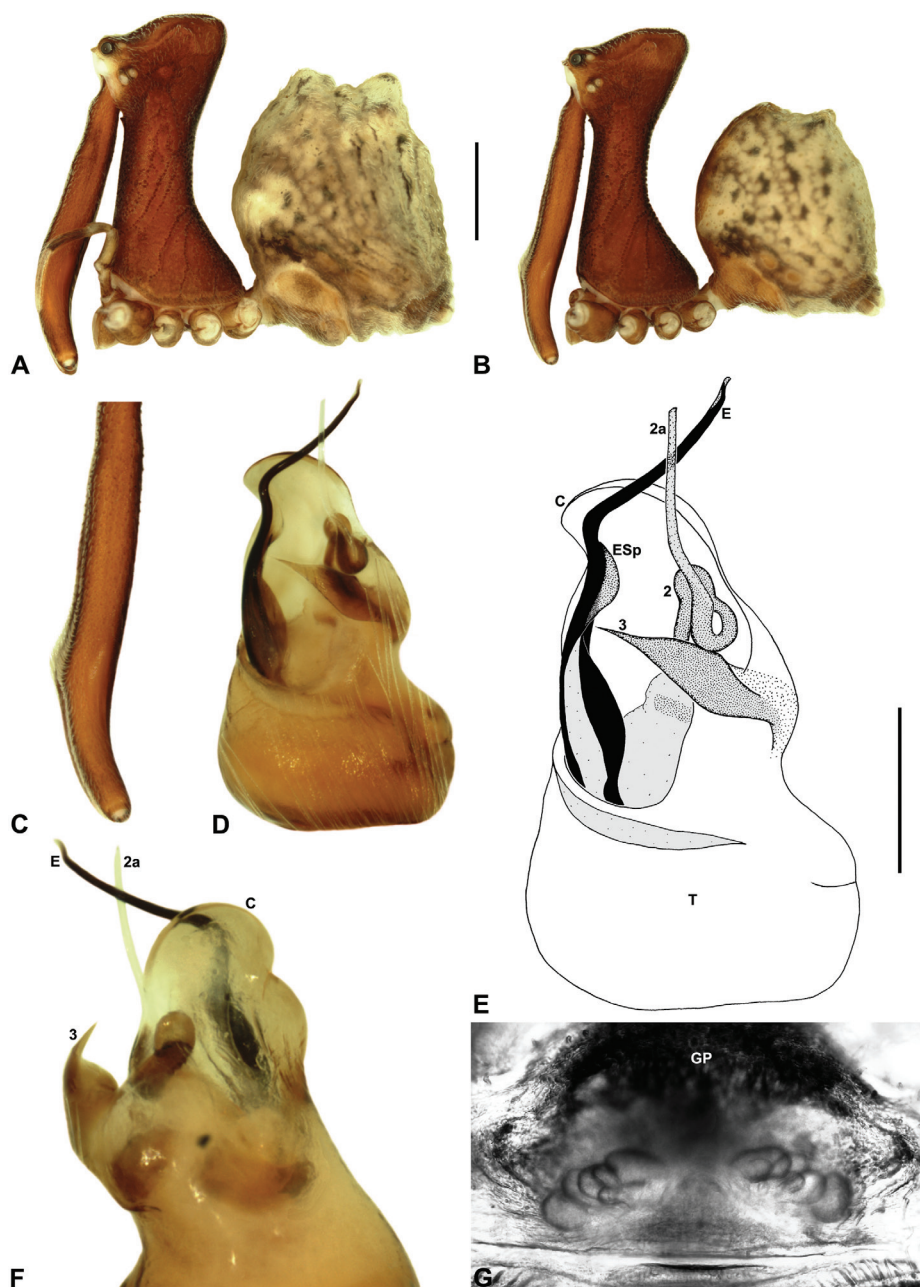


Figure 14. *Austrarchaea hoskini* sp. n. **A–B**, Cephalothorax and abdomen, lateral view: **A**, allotype female (QMB S17937) from Mount Elliot, Bowling Green Bay National Park, NE. Queensland; **B**, holotype male (QMB S30811) from Mount Elliot, Bowling Green Bay National Park, NE. Queensland. **C**, Holotype male chelicerae, lateral view, showing accessory setae. **D–F**, Holotype male pedipalp: **D–E**, bulb, ventral view; **F**, detail of distal regular sclerites, retrolateral view. **G**, Allotype female internal genitalia, postero-ventral view (as seen through posterior rim of genital plate). C = conductor; E = embolus; ES_p = embolic spur; GP = genital plate; T = tegulum; (TS)2–3 = regular sclerites 2–3. Scale bars: A–B = 1.0 mm; E = 0.2 mm.

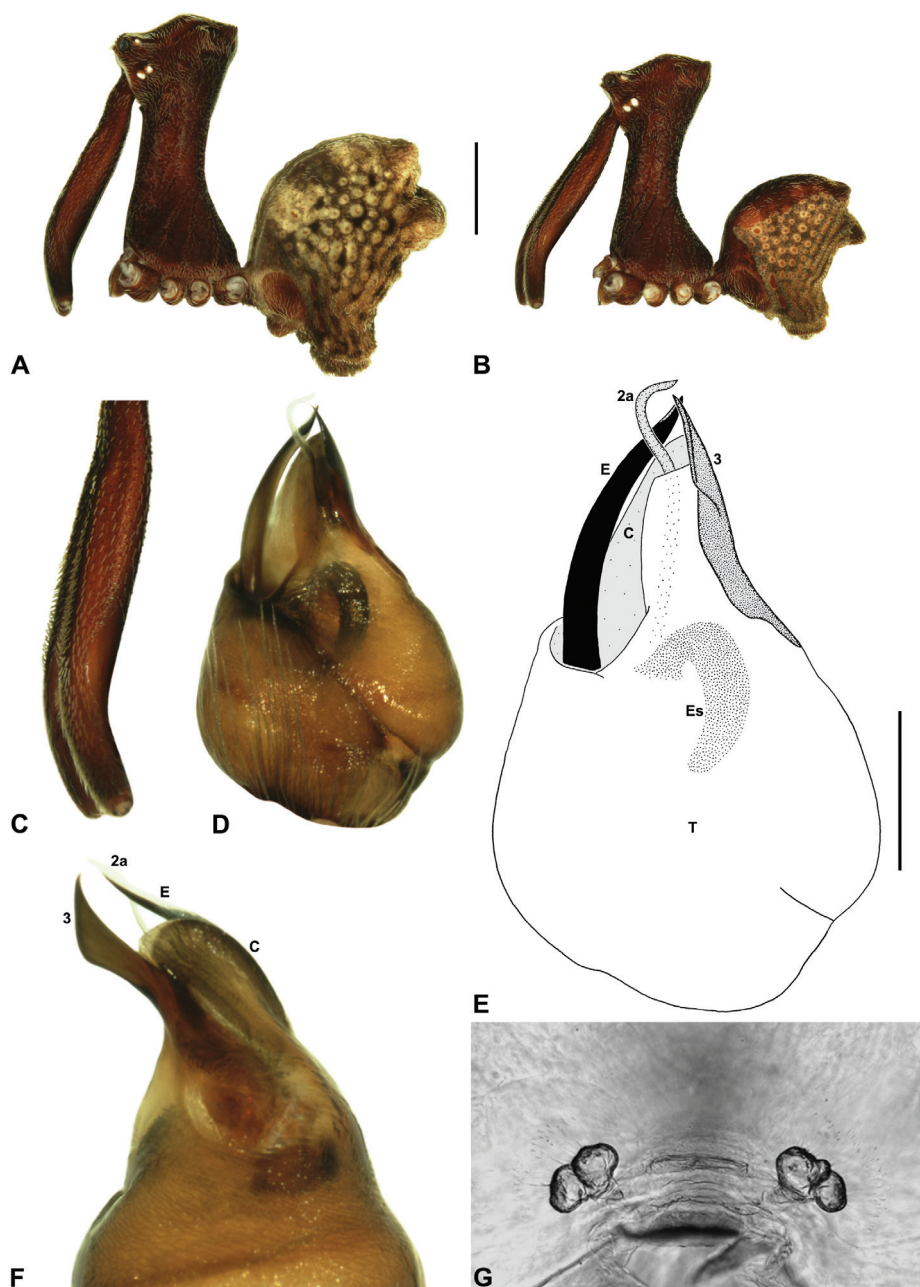


Figure 15. *Austrarchaea griswoldi* sp. n. **A–B**, Cephalothorax and abdomen, lateral view: **A**, allotype female (QMB S92213) from Broken River, Eungella National Park, NE. Queensland; **B**, holotype male (QMB S92212) from Broken River, Eungella National Park, NE. Queensland. **C**, Holotype male chelicerae, lateral view, showing accessory setae. **D–F**, Holotype male pedipalp: **D–E**, bulb, ventral view; **F**, detail of distal regular sclerites, retrolateral view. **G**, Allotype female internal genitalia, postero-ventral view (genital plate removed). C = conductor; E = embolus; Es = embolic sclerite; T = tegulum; (TS)1-3 = regular sclerites 1-3. Scale bars: A-B = 1.0 mm; E = 0.2 mm.

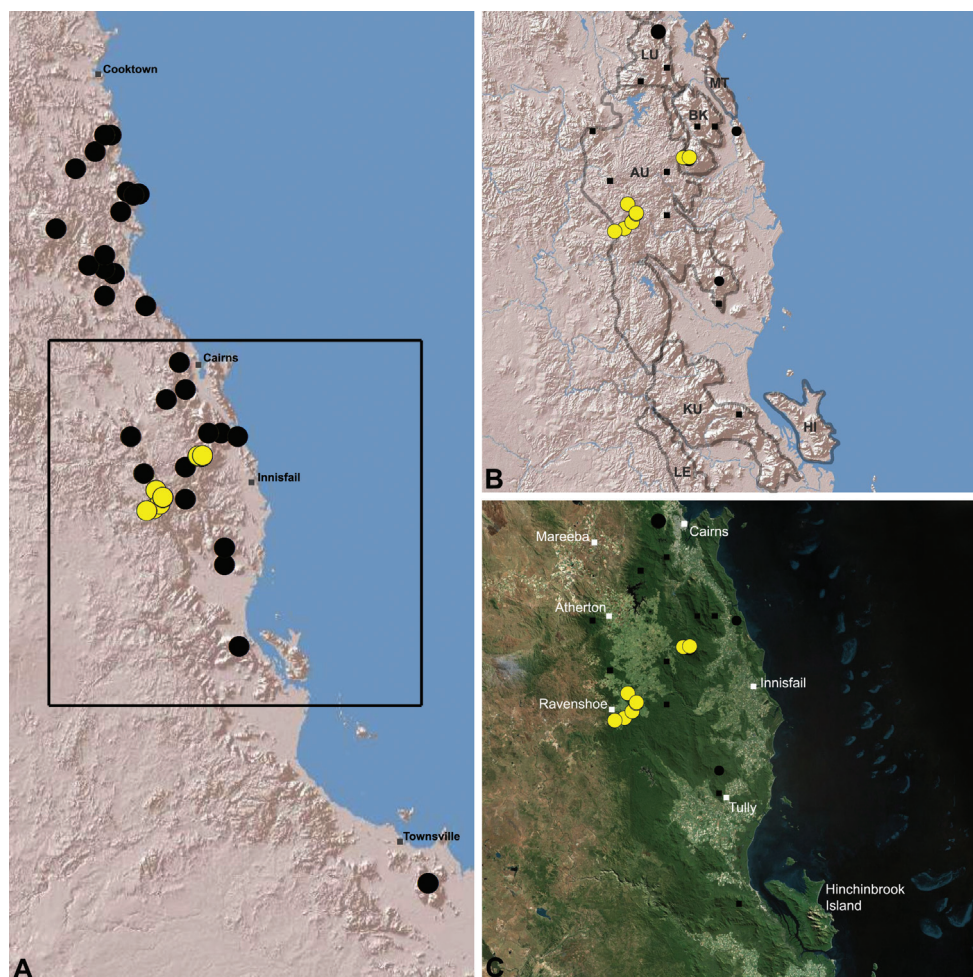


Figure 16. Distribution of *Austrarchaea daviesae* Forster & Platnick, 1984: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. daviesae* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the central Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. AU = Atherton Uplands; BK = Bellenden Ker/Bartle Frere; HI = Hinchinbrook Island; KU = Kirrama Uplands; LE = Lee Uplands; LU = Lamb Uplands; MT = Malbon-Thompson Uplands.

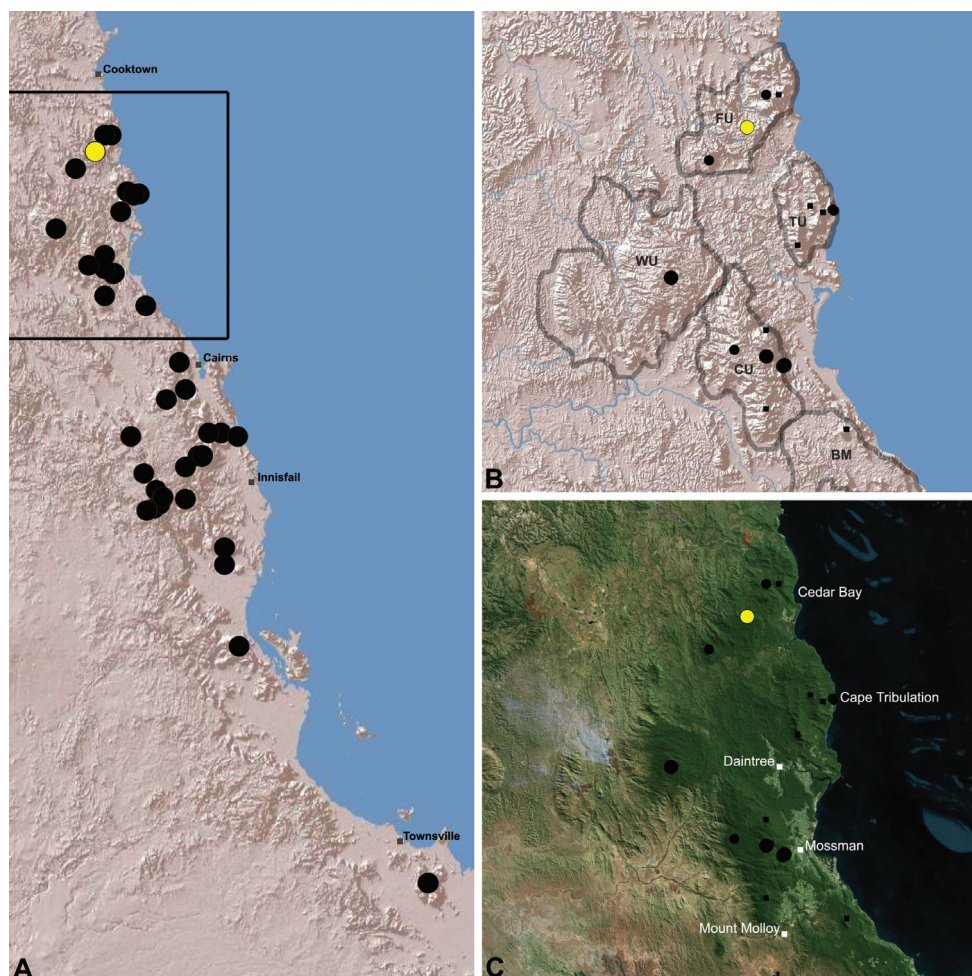


Figure 17. Distribution of *Austrarchaea wallacei* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. wallacei* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the northern Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. BM = Black Mountain Corridor; CU = Carbine Uplands; FU = Mt Finnigan Uplands; TU = Thornton Uplands; WU = Windsor Uplands.

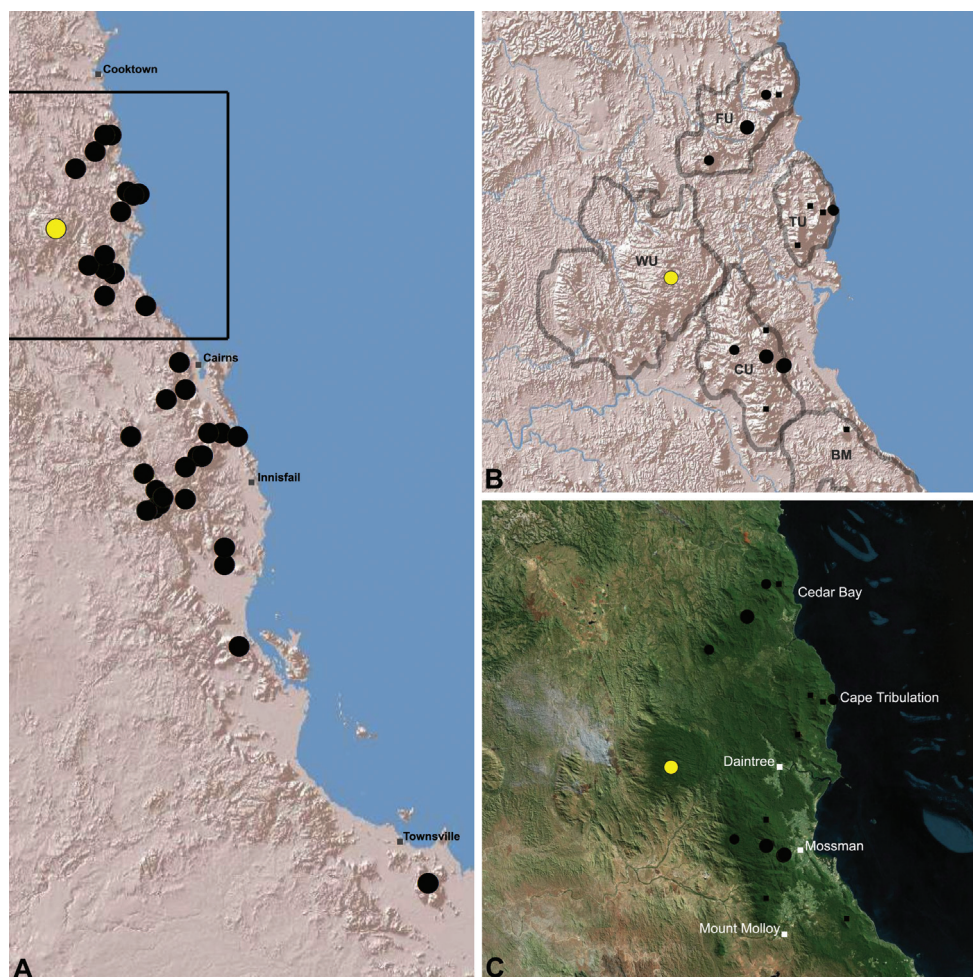


Figure 18. Distribution of *Austrarchaea karenae* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. karenae* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the northern Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. BM = Black Mountain Corridor; CU = Carbine Uplands; FU = Mt Finnigan Uplands; TU = Thornton Uplands; WU = Windsor Uplands.

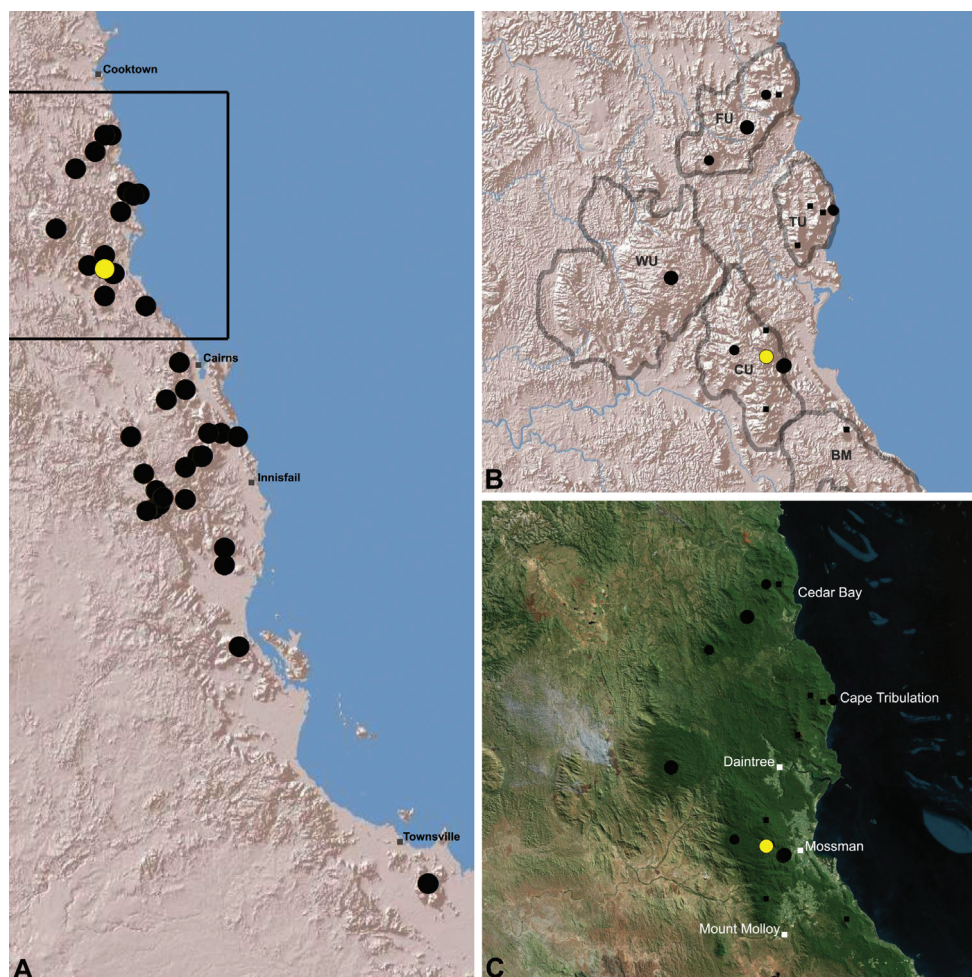


Figure 19. Distribution of *Austrarchaea thompsoni* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. thompsoni* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the northern Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. BM = Black Mountain Corridor; CU = Carbine Uplands; FU = Mt Finnigan Uplands; TU = Thornton Uplands; WU = Windsor Uplands.

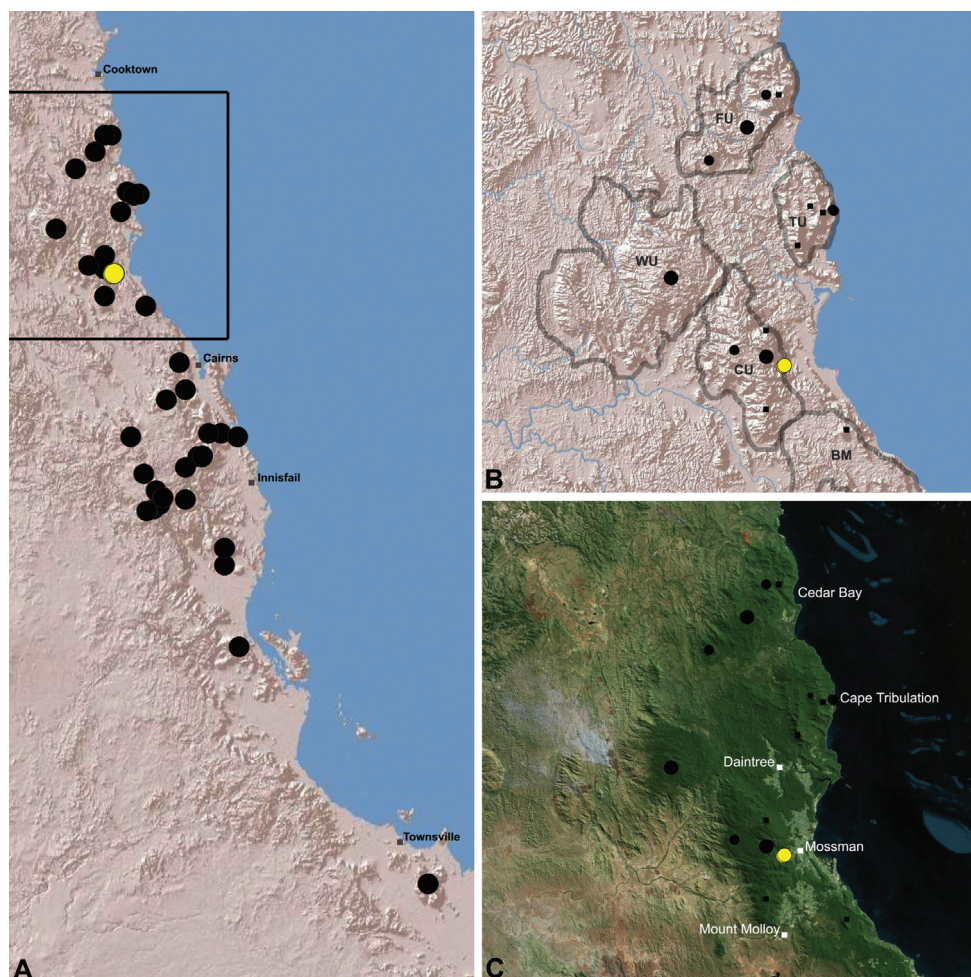


Figure 20. Distribution of *Austrarchaea tealei* sp. n.: **A**, topographic map showing the known distribution of Archæidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. tealei* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the northern Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. BM = Black Mountain Corridor; CU = Carbine Uplands; FU = Mt Finnigan Uplands; TU = Thornton Uplands; WU = Windsor Uplands.

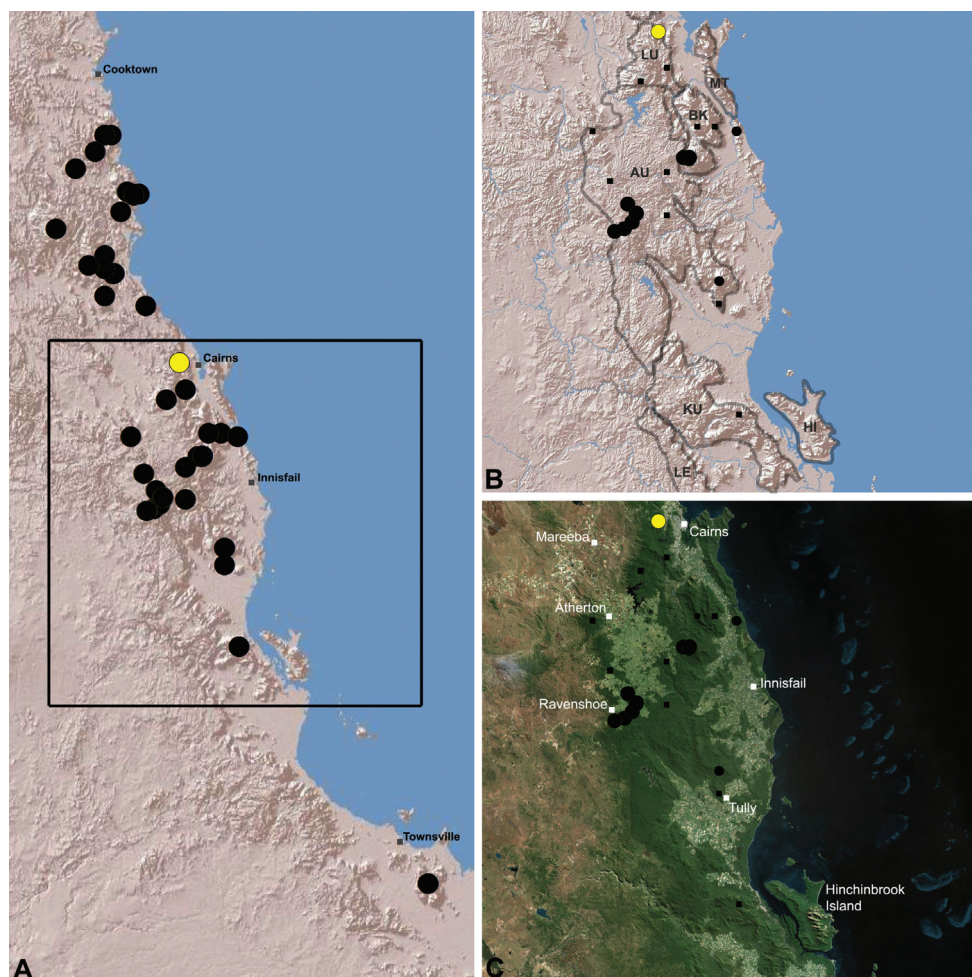


Figure 21. Distribution of *Austrarchaea westi* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. westi* highlighted in yellow; **B-C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the central Wet Tropics (modified from Edward 2011). Small squares in (B-C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. AU = Atherton Uplands; BK = Bellenden Ker/Bartle Frere; HI = Hinchinbrook Island; KU = Kirrama Uplands; LE = Lee Uplands; LU = Lamb Uplands; MT = Malbon-Thompson Uplands.

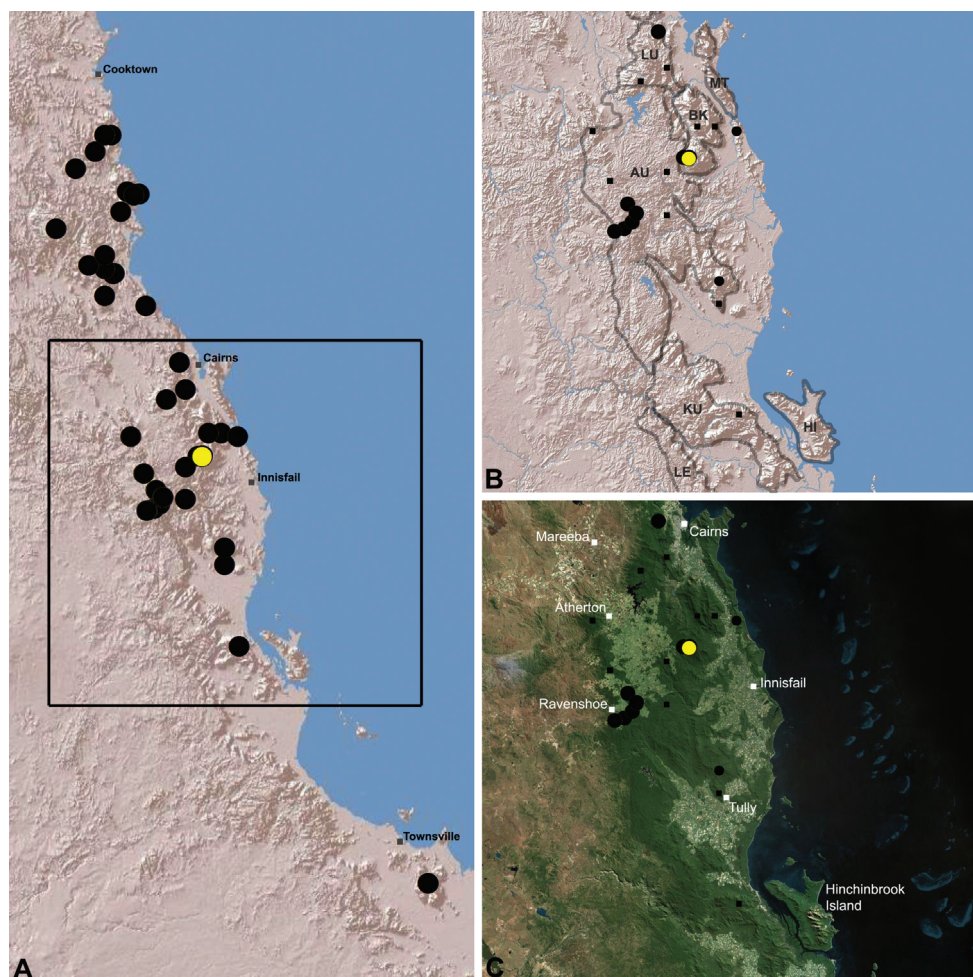


Figure 22. Distribution of *Austrarchaea woodae* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. woodae* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the central Wet Tropics (modified from Edward 2011). Small squares in (B–C) denote unidentified juvenile specimens; small circles denote unidentified female specimens; large circles denote described species of *Austrarchaea*. AU = Atherton Uplands; BK = Bellenden Ker/Bartle Frere; HI = Hinchinbrook Island; KU = Kirrama Uplands; LE = Lee Uplands; LU = Lamb Uplands; MT = Malbon-Thompson Uplands.

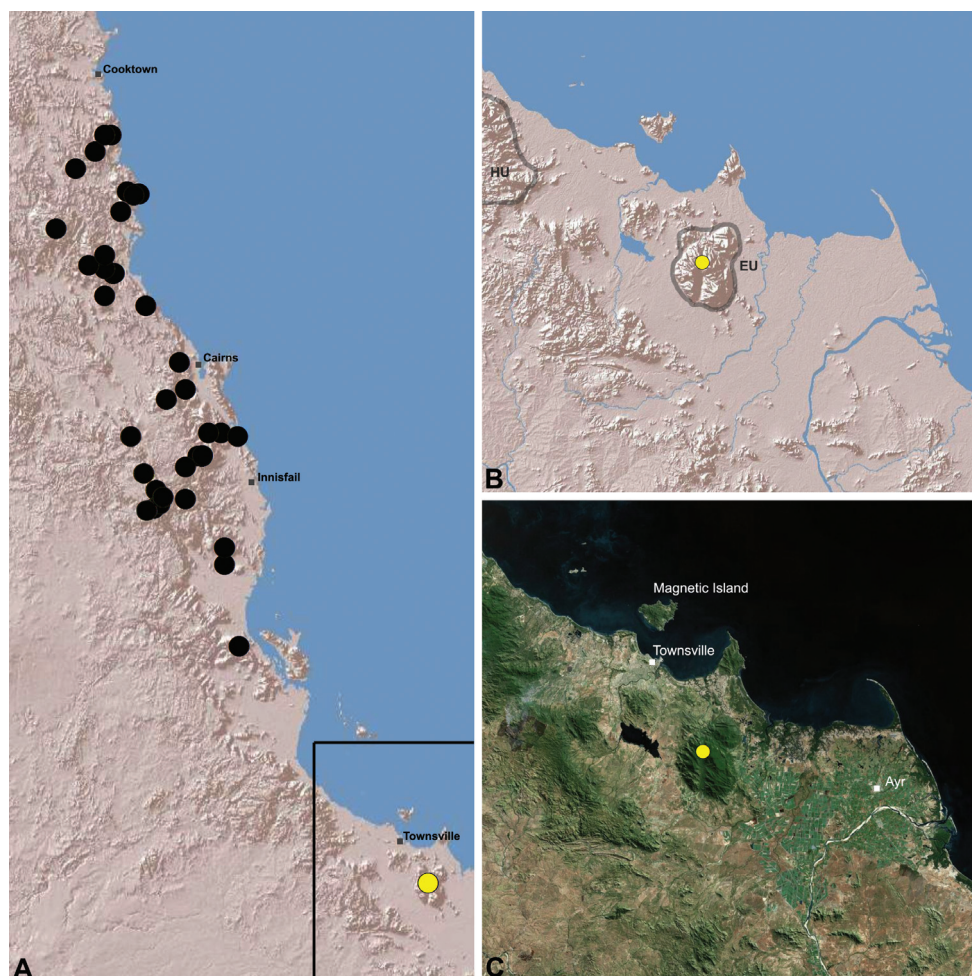


Figure 23. Distribution of *Austrarchaea hoskini* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Wet Tropics bioregion, with collection localities for *A. hoskini* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Labelled boundaries in (B) denote upland subregional zones of faunal endemism identified by Winter et al. (1984), Williams et al. (1996) and other authors for the southern Wet Tropics (modified from Edward 2011). EU = Elliot Uplands; HU = Halifax Uplands.

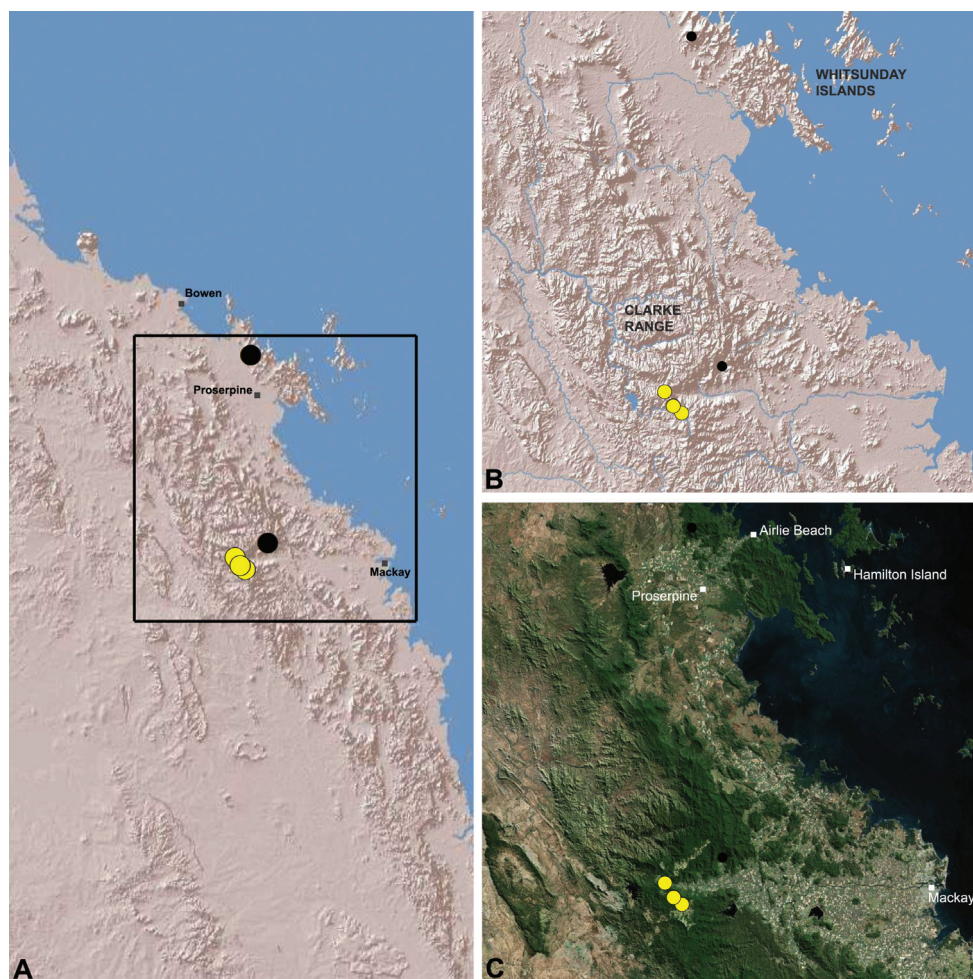


Figure 24. Distribution of *Austrarchaea griswoldi* sp. n.: **A**, topographic map showing the known distribution of Archaeidae in the north-eastern Queensland Mackay and Whitsundays Hinterland, with collection localities for *A. griswoldi* highlighted in yellow; **B–C**, topographic and satellite maps showing detail of inset (A). Small circles in (B–C) denote unidentified female specimens; large circles denote described species of *Austrarchaea*.

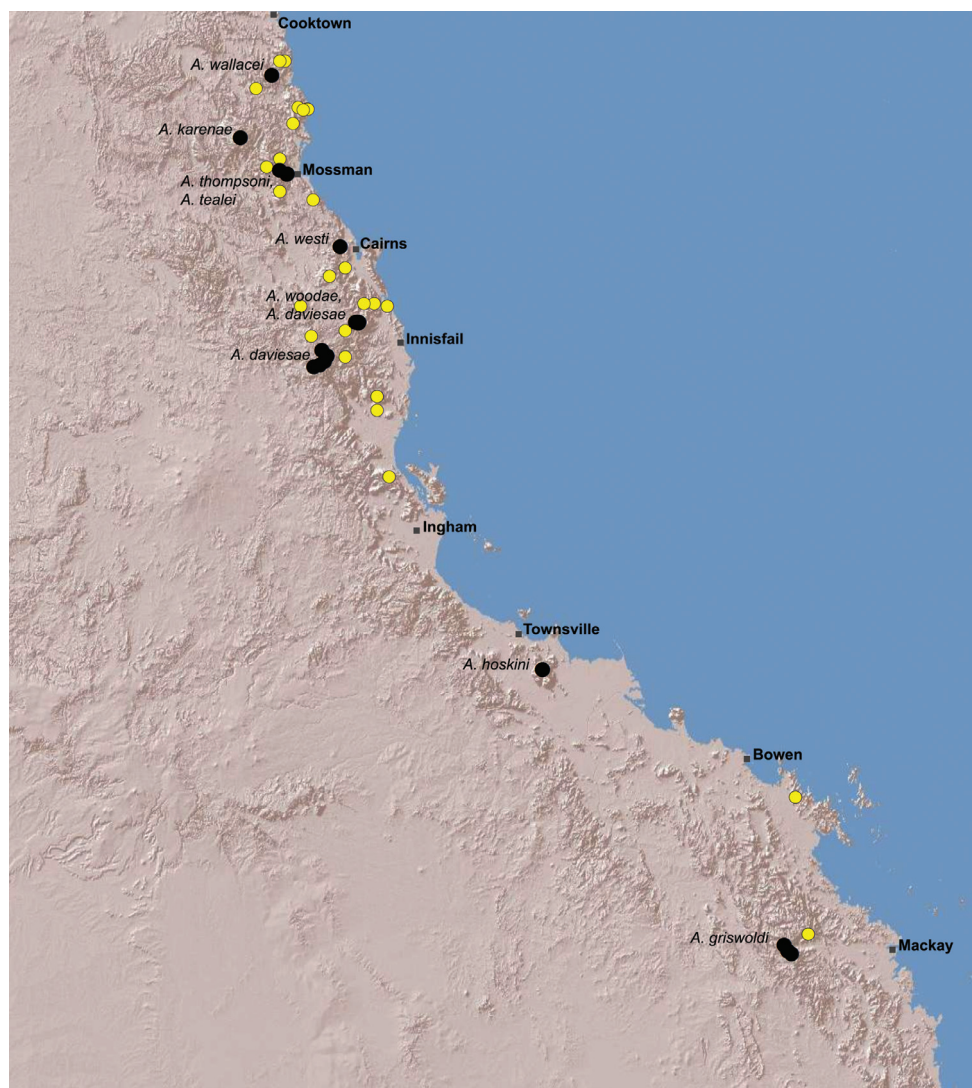


Figure 25. Summary distribution of the *Austrarchaea daviesae* species-group in tropical north-eastern Queensland, showing collections records for described species (labelled, with black circles) and unidentified juveniles or females (yellow circles) (see Table 1). Note the high proportion of unidentified specimens, especially within the Wet Tropics bioregion between Cooktown and Ingham.

Two new apterous species of *Lathrobium* Gravenhorst (Coleoptera, Staphylinidae, Paederinae) from Fujian, East China

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[urn:lsid:zoobank.org:pub:4AA36239-0336-436A-B391-100CE1B68B57](https://zoobank.org/urn:lsid:zoobank.org:pub:4AA36239-0336-436A-B391-100CE1B68B57)

Citation: Peng Z, Li L-Z, Zhao M-J (2012) Two new apterous species of *Lathrobium* Gravenhorst (Coleoptera, Staphylinidae, Paederinae) from Fujian, East China. ZooKeys 218: 57–63. doi: 10.3897/zookeys.218.3361

Abstract

Two new apterous species of the genus *Lathrobium* Gravenhorst, 1802 from Fujian Province, East China, *L. daocongchaoi* Peng & Li, **sp. n.** and *L. fujianense* Peng & Li, **sp. n.**, are described and illustrated.

Keywords

Coleoptera, Staphylinidae, taxonomy, *Lathrobium*, new species, Fujian, China

Introduction

So far, 62 species of the genus *Lathrobium* Gravenhorst, 1802 have been reported from China (Peng et al. 2012c), but none was previously known from Fujian Province, East China. Only eleven species have been reported from the adjacent Zhejiang Province (Watanabe and Luo 1992, 1999a, b; Peng et al. 2012a, b).

Recently, the first author and his colleagues made two collecting trips to Fujian Province and collected a small series of *Lathrobium*. The examination of the specimens revealed two species, both of which are remarkably different from the previously known species from China regarding their male sexual characters.

Material and methods

All specimens were collected from the leaf litter in broad-leaved forests by sifting. The following abbreviations are used in the text, with all measurements in millimeters:

- BL** length of body from the anterior margin of the labrum to the apex of the abdomen;
- FL** length of forebody from the anterior margin of the clypeus to the posterior margin of the elytra;
- HL** length of head from the anterior margin of the clypeus to the posterior margin of the head;
- HW** maximum width of head;
- PL** length of pronotum along midline;
- PW** maximum width of pronotum;
- EL** length of elytra from the apex of the scutellum to the posterior margin of the elytra.

The type material is deposited in the Insect Collection of Shanghai Normal University, Shanghai, China. (SNUC).

Descriptions

Lathrobium daicongchaoi Peng & Li, sp. n.

urn:lsid:zoobank.org:act:8FE90F67-320E-49F1-A324-67DEC71B6D5F

http://species-id.net/wiki/Lathrobium_daicongchaoi

Figs 1A, 2

Type material (3 ♂♂, 6 ♀♀). Holotype: ♂, labeled ‘CHINA: Fujian Prov. / Wuyishan City / Guadun Village / 27°44’N, 117°37’E / 26.v.2012, alt. 1,400 m / Dai & Peng leg.’. Paratypes: 2 ♀♀, same label data as holotype; 2 ♂♂, 3 ♀♀, same data, except ‘29.v.2012’; 1 ♀, same data, except ‘28.v.2012’.

Description. Measurements and ratios: BL 7.51–8.90, FL 3.72–4.00, HL 0.89–1.02, HW 1.02–1.15, PL 1.33–1.52, PW 1.13–1.24, EL 0.93–0.96, HL/HW 0.86–0.92, HW/PW 0.90–0.94, HL/PL 0.65–0.67, PL/PW 1.18–1.24, EL/PL 0.63–0.70.

Habitus as in Fig. 1A. Body brown with paler apex, legs light brown, antennae light brown to yellowish brown.

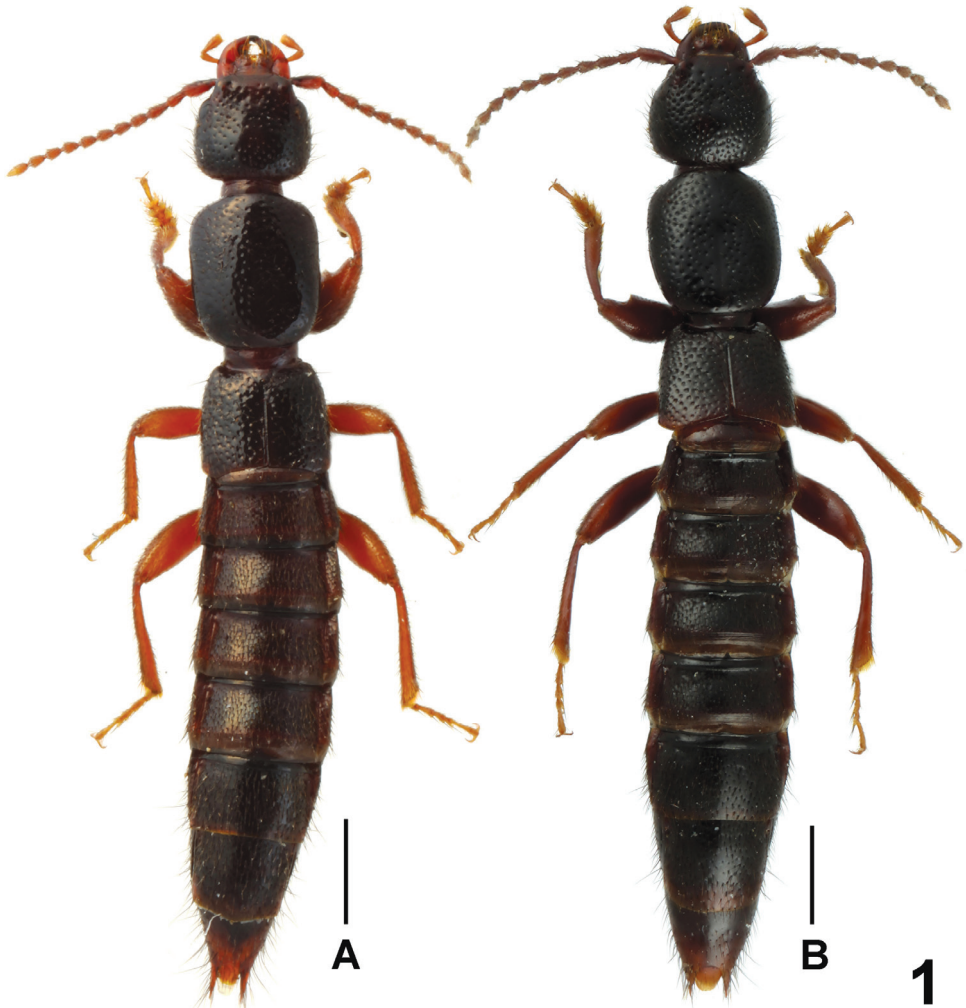


Figure 1. Male habitus of *Lathrobium* spp., **A** *L. daicongchaoi* **B** *L. fujianense*. Scales: 1.0 mm.

Head subquadrate (HL/HW 0.86–0.92); punctuation coarse and sparse; interstices with very shallow microreticulation; eyes small, approximately $1/3$ – $2/5$ the length of postocular region in dorsal view.

Pronotum nearly parallel-sided; punctuation sparser than that of head; impunctate midline narrow; interstices shining without microsculpture.

Elytra with punctuation denser than that of pronotum and well defined; hind wings reduced.

Abdomen with dense punctuation; interstices with very shallow, transversely striate microsculpture.

Male. Sternite VI (Fig. 2D) with dense darkish setae in postero-median impression; sternite VII (Fig. 2E) with sparse darkish setae in median impression, and poste-

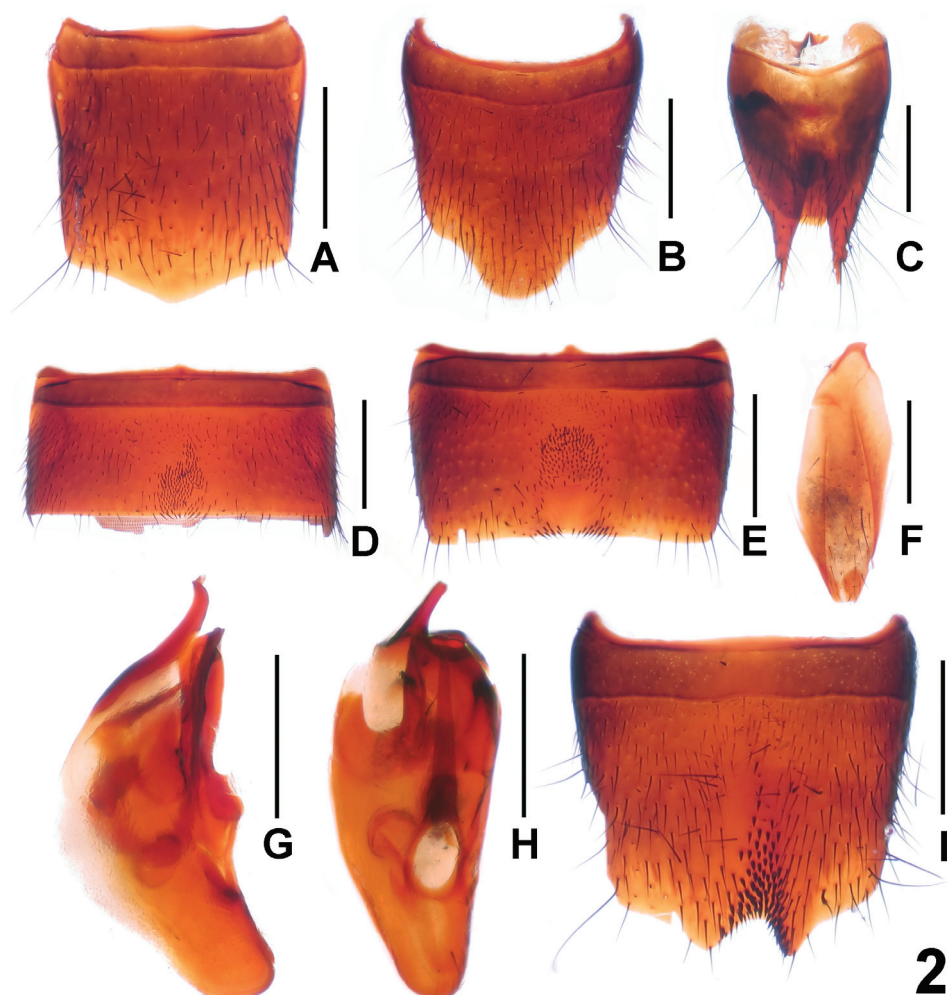


Figure 2. *Lathrobium daicongchaoi*. **A** female tergite VIII **B** female sternite VIII **C** female tergites IX–X **D** male sternite VI **E** male sternite VII **F** male sternite IX **G** aedeagus in lateral view **H** aedeagus in ventral view **I** male sternite VIII. Scales: 0.5 mm.

rior margin with several peg-like setae; sternite VIII (Fig. 2I) with asymmetric emargination and short darkish setae in shallow impression; sternite IX (Fig. 2F) nearly symmetric; aedeagus (Figs 2G, 2H) with short ventral process and thin dorsal sclerite.

Female. Posterior margin of tergite VIII (Fig. 2A) pointed in middle; sternite VIII (Fig. 2B) slightly longer than that of male, middle of posterior margin with broad and obtuse projection; tergite X (Fig. 2C) obtuse apically and not reaching anterior margin of tergite IX (Fig. 2C).

Distribution. East China: Fujian.

Etymology. The species is named after Cong-Chao Dai, collector of the type specimens.

Remarks. The new species resembles *L. zhaotiexiongi* Peng & Li, 2012 in having a postero-median impression on the male sternite VI and similarly shaped male sternite IX. The new species can be readily separated by the presence of a median impression on the male sternite VII and by the short ventral process of the aedeagus. In *L. zhaotiexiongi*, the male sternite VII lacks a median impression and has an asymmetric posterior emargination, and the ventral process of the aedeagus is longer.

***Lathrobium fujianense* Peng & Li, sp. n.**

urn:lsid:zoobank.org:act:7979EA9D-2FC1-4E70-AE5F-2A794BABF36F

http://species-id.net/wiki/Lathrobium_fujianense

Figs 1B, 3

Type material (1 ♂, 2 ♀♀). Holotype: ♂, labeled 'CHINA: Fujian Prov. / Mingxi County / Mt. Junzifeng / 26°34'N, 117°16'E / 7.viii.2008, alt. 1,400 m / Qi & Yin leg.'. Paratypes: 2 ♀♀, same label data as holotype.

Description. Measurements and ratios: BL 7.78–9.73, FL 3.77–4.05, HL 1.11–1.13, HW 1.24–1.26, PL 1.48–1.54, PW 1.30–1.33, EL 0.93–0.96, HL/HW 0.90, HW/PW 0.95, HL/PL 0.73–0.75, PL/PW 1.14–1.16, EL/PL 0.62–0.63.

Habitus as in Fig. 1B. General appearance similar to that of *L. daicongchaoi*, except for the darker coloration, somewhat larger body size, denser punctation on head and pronotum, and the weakly convex lateral margins of pronotum in dorsal view.

Male. Sternite V (Fig. 3A) with darkish setae in postero-median impression, and posterior margin with several point-like setae; sternite VI (Fig. 3C) similar to sternite V, but with much fewer point-like setae; posterior margin of sternite VII (Fig. 3E) weakly concave; sternite VIII (Fig. 3G) with subtriangular, weakly asymmetric emargination and short darkish setae in the narrow median impression; sternite IX (Fig. 3H) nearly symmetric; aedeagus (Fig. 3I, 3J) with long ventral process and short dorsal sclerite.

Female. Posterior margin of tergite VIII (Fig. 3B) broadly convex; sternite VIII (Fig. 3D) longer than that of male, middle of apical margin with obtuse projection; tergite X (Fig. 3F) broadly convex apically and not reaching anterior margin of tergite IX (Fig. 3F).

Distribution. East China: Fujian.

Etymology. The specific epithet is derived from Fujian Province, where the type locality is situated.

Remarks. The new species can be separated from other East Chinese *Lathrobium* species by the morphology of the aedeagus, as well as by the presence of point-like setae at the posterior margin of the male sternite V and by the presence of short dark setae in the narrow postero-median impression of the male sternite VIII.

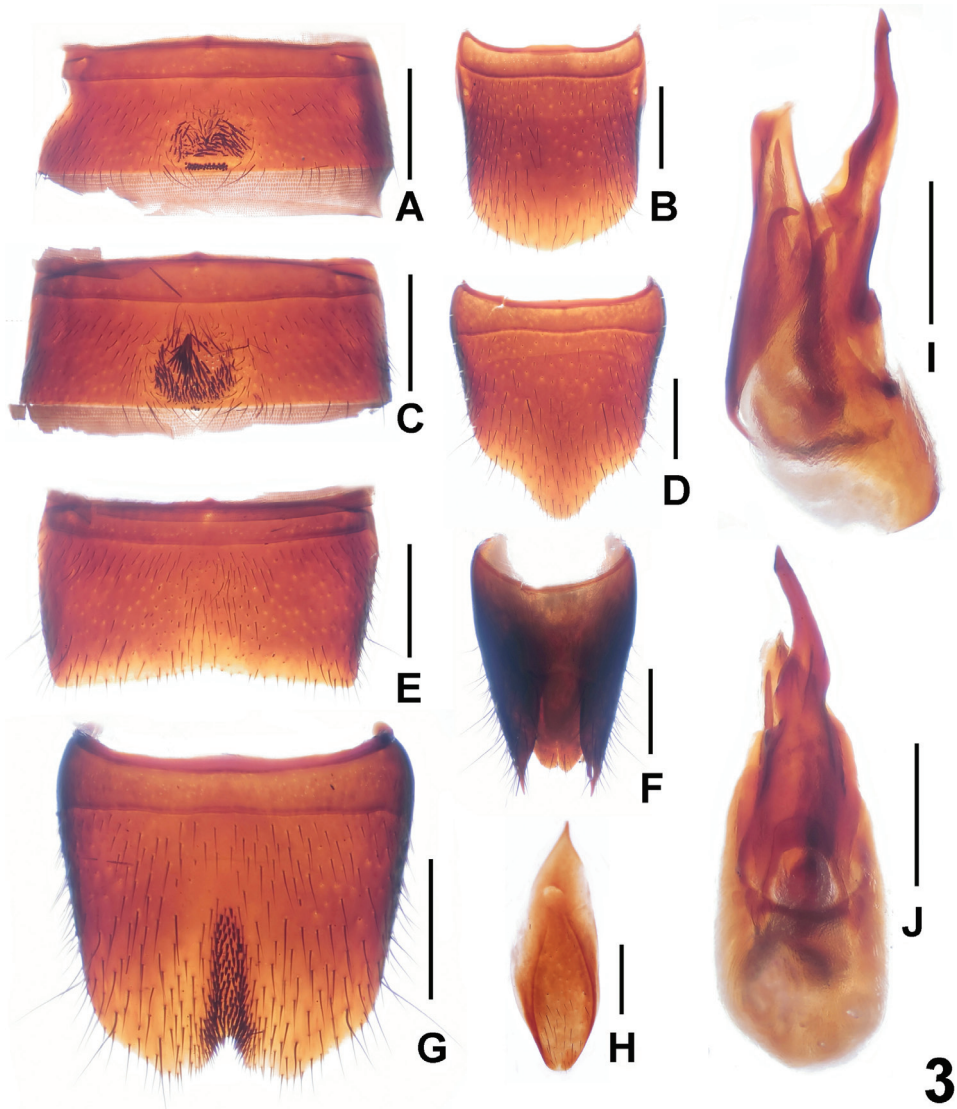


Figure 3. *Lathrobium fujianense*. **A** male sternite V **B** female tergite VIII **C** male sternite VI **D** female sternite VIII **E** male sternite VII **F** female tergites IX–X **G** male sternite VIII **H** male sternite IX **I** aedeagus in lateral view **J** aedeagus in ventral view. Scales: 0.5 mm.

Acknowledgements

All the collectors mentioned in the text are acknowledged for their field work. The study is supported by the National Natural Science Foundation of China (No. 31101659 and No. 31172134), the Foundation of Shanghai Municipal Education Commission (No. 12YZ077) and Shanghai Normal University (No. SK201234). We thank the two anonymous reviewers for comments on the manuscript.

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New species of *Vomerina* Winterton (Diptera, Therevidae, Agapophytinae) from Australia

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Citation: Winterton SL, Ferguson DJ (2012) New species of *Vomerina* Winterton (Diptera, Therevidae, Agapophytinae) from Australia. ZooKeys 218: 65–75. doi: 10.3897/zookeys.218.2380

Abstract

Two new species of *Vomerina* Winterton, 2007 (*V. comapensis* **sp. n.** and *V. micora* **sp. n.**) are described from New South Wales (Australia).

Keywords

Asiloidea, Therevidae, Australia

Introduction

The endemic Australasian stiletto fly (Diptera: Therevidae) fauna is exclusively placed in two subfamilies, Agapophytinae and Therevinae (Winterton 2009, 2011). A key to genera of the region can be found in Winterton (2011). Therevinae are a diverse, cosmopolitan subfamily while Agapophytinae are endemic to Australasia and South America. Agapophytinae comprise 197 species in 26 genera; 23 genera in Australasia and three genera (*Entesia* Oldroyd, 1968, *Melanotherewa* Malloch, 1932 and *Pachyrhiza* Philippi, 1865) in Argentina and Chile (Winterton 2006). *Vomerina* Winterton,

2007 is a previously monotypic Australian genus of distinctively black stiletto flies with a matte white to silver pleural stripe. The genus can be differentiated from all other Agapophytinae by this coloration, and by the male gonocoxites having a large plow-shaped ventral lobe and lacking a medial atrium. *Vomerina* is the putative sister genus to *Bonjeania* Irwin & Lyneborg, 1989, another endemic Australian genus of 18 described species (Winterton 2007). Two new species of *Vomerina* (*V. comapenis* sp. n. and *V. micora* sp. n.) are described and figured herein from New South Wales (Australia). A revised diagnosis of *Vomerina* and a key to species are also presented.

Material and methods

Adult morphological terminology follows McAlpine (1981) as modified by Winterton et al. (1999a) and Winterton (2006). Genitalia were macerated in 10% KOH at room temperature for one day to remove soft tissue, then rinsed in distilled water and dilute acetic acid, and dissected in 80% ethanol. Preparations were then placed into glycerine, with images made with the aid of a digital camera. Specimen images at different focal points were taken using a digital camera and subsequently combined into a serial montage image using Helicon Focus (©HeliconSoft). Genitalia preparations were placed in glycerine in a genitalia vial mounted on the pin beneath the specimen. The following collection acronyms are cited in the text: Australian National Insect Collection (Canberra) (ANIC), Australian Museum (AM).

Taxonomy

Vomerina Winterton, 2007

urn:lsid:zoobank.org:act:7781FCA5-2F6F-49CF-B629-1CAB9799A914

<http://species-id.net/wiki/Vomerina>

Type species. *Vomerina humbug* Winterton, 2007: 22.

Diagnosis. Body length 6.5–8.0 mm. Body glossy black with matte white (or silver) lateral stripe of dense pubescence on pleuron, usually extending to anterior segments of abdomen; male frons wider than ocellar tubercle at narrowest point; parafacial setae absent; male with single row of postocular setae; lower frons and face slightly to greatly protruding anteriorly; antenna length shorter than or equal to head length; scape cylindrical or bulbous; flagellum conical, style terminal; sternum with medial furrow lacking setal pile; posterior surface of mid coxa lacking setal pile; wing cell m_3 closed; elongate velutum patches present on fore and hind femora; femora without macrosetae; male genitalia without medial atrium, inner gonocoxal process absent or greatly reduced; ventral lobe large, plowshare-shaped, projecting posteromedially with dense medial covering of velutum; dorsal apodeme of parameral sheath well sclerotized; ejaculatory apodeme and lateral ejaculatory apodeme short; gonocoxal apodeme much shorter than

gonocoxite length; female with three spermathecae; spermathecal ducts joined to common spermathecal sac duct; acanthophorite spines A1 and A2 present, well developed.

Comments. Winterton (2007) erected *Vomerina* based on the male of *V. humbug*. The stripe of pubescence on the lower portion of the pleuron is distinctively matte white (almost glaucous gray) in *V. humbug* and *V. comapenis* sp. n., where it continues onto the posterior surface of the head and onto the anterior segments of the abdomen. In *V. micora* sp. n., the stripe of dense pubescence is present only on the thorax and is silver. This type of pleural stripe is also found in many species of *Bonjeania* (e.g. *B. zwicki* Winterton, 2007) and numerous species of *Parapsilocephala* Kröber, 1912 and *Acraspisa* Kröber, 1912. There is a distinct similarity in body shape between *Vomerina* and certain *Bonjeania* species such as *B. webbi* Winterton 2007 and *B. bapsis* Winterton, 2007. All have a conical head and similar body shape, but most *Bonjeania* species lack the distinct pleural stripe of pubescence, have a medial atrium and small ventral lobe on the male gonocoxites, while females have only a single spermatheca.

Included species. *Vomerina comapenis* sp. n., *V. humbug* Winterton, 2007, *V. micora* sp. n.

Key to *Vomerina* species

- 1 Wing with costal area slightly infusate, rest of wing hyaline; frons strongly projecting anteriorly; scape longer than flagellum, bulbous; pale setae on katatergite..... ***V. humbug* Winterton, 2007**
- Wing infuscation more extensive; frons projecting only slightly; scape shorter than flagellum, cylindrical, not bulbous; dark setae on katatergite..... **2**
- 2 Matte white lateral pubescence extending from pleuron onto anterior segments of abdomen as a continuous stripe; hind tibia with yellow band midway ***V. comapenis* sp. n.** (Figs 1–2)
- Silver lateral pubescence on pleuron only, absent from abdomen; hind tibia without yellow band ***V. micora* sp. n.** (Figs 5–7)

Vomerina comapenis sp. n.

urn:lsid:zoobank.org:act:9249B712-FFB3-47A7-A34F-89EC0ECE7461

http://species-id.net/wiki/Vomerina_comapenis

Figs 1–4

Type material. – **Holotype** male, AUSTRALIA: **New South Wales:** Boonanghi State Forest, 24 km W Kempsey, vic.[inity of] ‘The Blowhole’ [–31.0747, 152.5663], 8.x.1993, G. & A. Williams, riparian zone, dry rainforest (AM).

Diagnosis. Wing dark infusate; frons slightly projecting around antennal base; scape cylindrical, shorter than flagellum, not bulbous; black setae on katatergite; white pubescence on pleuron extending onto abdomen; male abdomen black apically; articulated inner gonocoxal process present, greatly reduced.



Figure 1. *Vomerina comapensis* sp. n., male habitus, oblique view. Body length = 7.0 mm.



Figure 2. *Vomerina comapensis* sp. n., male habitus, lateral view. Body length = 7.0 mm.



Figure 3. *Vomerina comapenis* sp. n., male terminalia, lateral view. Scale line = 0.2 mm.

Description. Body length: 7.0 mm. *Head.* Frons flat, surface rugose-striated medially, wider than ocellar tubercle at narrowest point, antennal base positioned low on frons; lower frons and face slightly protruding around antennal base; frons glossy black, silver-grey pubescence along eye margin; short setae sparsely distributed on lower frons; narrow medial stripe of silver pubescence around antennal bases on face, parafacial and along margin of eye; ocellar tubercle flat, glossy black; occiput concave, black, overlain with dense grey pubescence; single row of very short, black postocular setae; gena black, overlain with white pubescence admixed with white, elongate setae; palpus and labellum brown-black with sparse, dark setae; antenna black, only



Figure 4. *Vomerina comapensis* sp. n., male terminalia, ventral view. Scale line = 0.2 mm.

slightly shorter than head; short dark setae on scape and pedicel; scape shorter than flagellum length, cylindrical, with grey pubescence; flagellum conical with brownish suffusion. *Thorax*. Black, scutum and scutellum overlain with grey-black pubescence admixed with relatively short, dark setae; scutum with narrow, faint dorsocentral and medial stripe of pale grey pubescence; scutal macrosetae black; pleuron, sternum and coxae glossy black; distinctive broad stripe of matte white to silver pubescence along pleuron length; elongate pale setae on proepisternum, katepisternum and coxae, black setae on anepisternum and katatergite; legs black with pale setae of various lengths on femora, dark yellow band midway on mid and hind tibiae and basitarsus; wing smoky infusate; venation dark; haltere brown-black; scutal chaetotaxy (pairs): notopleural,

4; supra alar, 1; post alar, 1; dorsocentral, 1–2; scutellar, 1. *Abdomen*. Glossy black, uniform scattered pale setae, longer laterally, white-grey pubescence laterally on sternites 1–3. *Male genitalia*. Gonocoxite with outer gonocoxal processes reduced; articulated inner gonocoxal process greatly reduced; gonostylus broad; ventral lobe large, plowshare-shaped, projecting posteroventrally with velutinous pubescence on ventral surface (Figs 3–4).

Etymology. The species epithet is derived from the Latin, *coma* hairy; *penis*, intro-
mitant organ; referring to the vestiture of the male genitalia.

Comments. *Vomerina comapenis* sp. n. is much smaller in body size to *V. humbug* and can be further distinguished by the frons being only slightly projecting, a non-bulbous antennal scape and darker wings. This species is distinguished from *V. micora* sp. n. by the lateral velutum stripe extending onto the abdomen, abdomen uniformly black, and the scutum lacking grey pubescent dorsocentral stripes. The female is unknown.

***Vomerina micora* sp. n.**

urn:lsid:zoobank.org:act:79F15746-5D56-4BB6-8D2A-4CF20E68AC0F

http://species-id.net/wiki/Vomerina_micora

Figs 5–7

Type material. – **Holotype** female, AUSTRALIA: **New South Wales:** South Black Range, 8 km E Hoskinstown, Fluoro U.V. light trap [–35.4183, 149.5347], 11.ii.2010, 1180m D. J. Ferguson (ANIC 29 029246)

Diagnosis. Wing dark infusate; scape cylindrical, shorter than flagellum; black setae on katatergite; silver pubescence on pleuron not extending onto abdomen; scutum with two faint dorsocentral stripes bordering a darker medial stripe; female abdominal segments 7–8 orange.

Description. Body length: 6.5 mm. *Head*. Frons flat, rugose-striated medially, wider than ocellar tubercle at narrowest point, antennal base positioned low on frons; lower frons and face protruding only slightly with curved ridge above antennal base; frons glossy black, short setae sparsely distributed on upper frons, silver-grey pubescence on parafacial, oral cavity and along eye margin; ocellar tubercle flat, black; occiput concave, black, overlain with grey pubescence; few relatively strong short black postocular setae followed by weaker setae in several irregular rows; elongate black setae along lower postocular admixed with white setae along gena; gena black, overlain with silver-grey pubescence; palpus and labellum brown-black with sparse, dark setae; antenna two-thirds length of head; scape and pedicel black with short dark setae; scape about half length of flagellum, cylindrical, with grey pubescence; flagellum with red-brownish suffusion and grey pubescence. *Thorax*. Glossy black; scutum and scutellum overlain with grey-black pubescence



Figure 5. *Vomerina micora* sp. n., female habitus. Body length = 8.0 mm.

admixed with relatively short, dark setae; scutum with pair of narrow dorsocentral stripes of sparse pale-grey pubescence bordering a darker medial stripe; scutal macrosetae black; pleuron and sternum glossy black; broad stripe of silver pubescence along pleuron from proepisternum to hind coxa; fore and middle coxae dark brown, hind coxa black; posterior surface of hind coxa with silver pubescence; elongate pale setae on proepisternum and coxae, black setae on katatergite; fore and middle femora dark brown, hind femur black; elongate yellowish-grey velutum patches to ventral surface of hind and apical half of fore femora; pale setae of various lengths on all femora; tibiae black to dark brown; mid and hind basitarsi dark yellow basally; wing dark infusate, venation and stigma dark grey; haltere matte brown; scutal chaetotaxy (pairs): notopleural, 4; supra alar, 1; post alar, 1; dorsocentral, 4; scutellar, 1. *Abdomen.* Glossy black with short dark setae distributed evenly; erect whitish setae laterally on segments 1 and 2; segments 7 and 8 orange in colour with sparse, erect black setae. *Female genitalia.* Three spermathecae and a relatively small, simple spermathecal sac.

Etymology. The species epithet is derived from Latin, *mico* shine; *ora* border; reference to the silver-grey pubescence border of the eye.

Comments. *Vomerina micora* sp. n. is more slender in body than *V. humbug* and *V. comapensis* sp. n. and can be distinguished by the dorsocentral stripes on the scutum, short, cylindrical scape, and the pleural stripe not extending onto the abdomen. The orange terminal abdominal segments may prove to be a sexually dimorphic character, as is found in many other therevid species. The male is unknown.



Figure 6. *Vomerina micora* sp. n., female habitus, oblique view. Body length = 8.0 mm.



Figure 7. *Vomerina micora* sp. n., female habitus, lateral view. Body length = 8.0 mm.

Acknowledgements

We thank Mr. Chris Manchester (CSIRO) for preparing the photographic images of *V. micora* sp. n. This research was supported by the National Science Foundation (NSF-DEB-0614213) and the Australian Biological Resource Study (ABRS-209-48) to SLW. Statements and viewpoints expressed herein do not necessarily reflect the opinion of NSF or ABRS.

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The apid cuckoo bees of the Cape Verde Islands (Hymenoptera, Apidae)

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Abstract

The apid cuckoo bees of the Cape Verde Islands (Republic of Cape Verde) are reviewed and five species recognized, representing two genera. The ammobatine genus *Chiasmognathus* Engel (Nomadinae: Ammobatini), a specialized lineage of cleptoparasites of nomioidine bees is recorded for the first time. *Chiasmognathus batelkai* **sp. n.** is distinguished from mainland African and Asian species. The genus *Thyreus* Panzer (Apinae: Melectini) is represented by four species – *Thyreus denolii* **sp. n.**, *T. batelkai* **sp. n.**, *T. schwarzi* **sp. n.**, and *T. aistleitneri* **sp. n.** Previous records of *Thyreus scutellaris* (Fabricius) from the islands were based on misidentifications.

Keywords

Apoidea, Anthophila, Apidae, cleptoparasite, taxonomy, *Thyreus*, *Chiasmognathus*, Cape Verde Islands

Introduction

Although the bees of isolated archipelagos are of considerable interest and have usually attracted some degree of melittological interest, those species of the Republic of Cape Verde have been only anecdotally treated (Kirby 1884; Groh 1982; Simon Thomas and Wiering 1993; Báez et al. 2005), except for a contribution regarding samples of the family Halictidae (Pauly et al. 2002). There have been only 10 scientific expedi-

tions which studied Hymenoptera in this archipelago over the course of 150 years of historical research (Table 1). Recent collecting efforts in the islands are therefore of considerable interest and provide greater information on the fauna. Herein we provide a taxonomic overview of the apid cuckoo bee fauna from the Cape Verde Islands, based on newly collected material as well as revision of material collected in the past. In total two genera are recognized. The genus *Thyreus* Panzer is represented by four species, all new and endemic to the islands, although some were misidentified as the otherwise more widespread Mediterranean and Asiatic species, *Thyreus scutellaris* (Fabricius) [(e.g., Kirby 1884; Báez et al. 2005 (both as “*scutellatus*”)]. Simon Thomas and Wiering (1993) suggested this was a mistake and correctly associated their material of *Thyreus* as related to *T. ramosus* (Lepeletier de Saint Fargeau) (as “aff. *ramosus*”). The genus *Chiasmognathus* Engel is newly recorded from the Cape Verde Islands and is represented by a single new species, cleptoparasitic upon *Ceylalictus capverdensis* Pesenko, Pauly, and La Roche (Pauly et al. 2002). The only other parasitic bee known from the Cape Verde Islands is *Sphecodes pinguiculus* Pérez, formerly described as an endemic species (*S. capverdensis* Pauly and La Roche: Pauly et al. 2002) but recently recognized as this widespread Palearctic species and synonymized (Bogusch and Straka 2012). The host of *Chiasmognathus* was treated by Pauly et al. (2002), while species of the genus *Amegilla* Friese, the hosts of the *Thyreus*, are currently under study (Engel and Straka in prep.).

Table 1. A list of expeditions and names of collectors of bees who visited the Cape Verde Islands and provided their material for scientific studies.

Collector(s)/Expedition(s)	Dates	Current Repository of Material
HMS Challenger Expedition	1873	presumably NHML
L. Fea	1898	presumably MSNG, SEMC
H. Lindberg	1953–1954	MZH
A. van Harten	1963–1990	RMNH
E. Bauber, B. Friebe, K. Groh, H. Hölzel, W. Lobin, P. Ohm, B. Traub	1978–1980	FISC
R.T. Simon Thomas	1988	RMNH
F. La Roche	1998–1999	Personal coll., MICN
E. Aistleitner	1999–2009	Personal coll., NMPC, SEMC
J. Straka, J. Batelka	2009–2011	Personal coll., NMPC, SEMC

Material and methods

The material considered herein is located in the following institutional and personal repositories: **EAFC**, Eyjolf Aistleitner, Feldkirch, Austria; **NMPC**, Department of Entomology, National Museum, Prague, Czech Republic; **FISC**, Forschungsinstitut Senckenberg, Frankfurt am Main, Germany, **JSPC**, Jakub Straka Collection, Charles University in Prague, Prague, Czech Republic; and **SEMC**, Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA. Abbreviations of additional repositories referred to in Table 1 are as follows: **NHML**, The Natural History Museum, London, United Kingdom; **MSNG**, Museo Civico di Storia Naturale

“Giacomo Doria”, Genoa, Italy; **MICN**, Museo Insular de Ciencias Naturales, Tenerife, Canary Islands, Spain; **MZH**, Finnish Museum of Natural History, Helsinki, Finland; **RMNH**, Nationaal Natuurhistorische Museum (“Naturalis”), Leiden, The Netherlands.

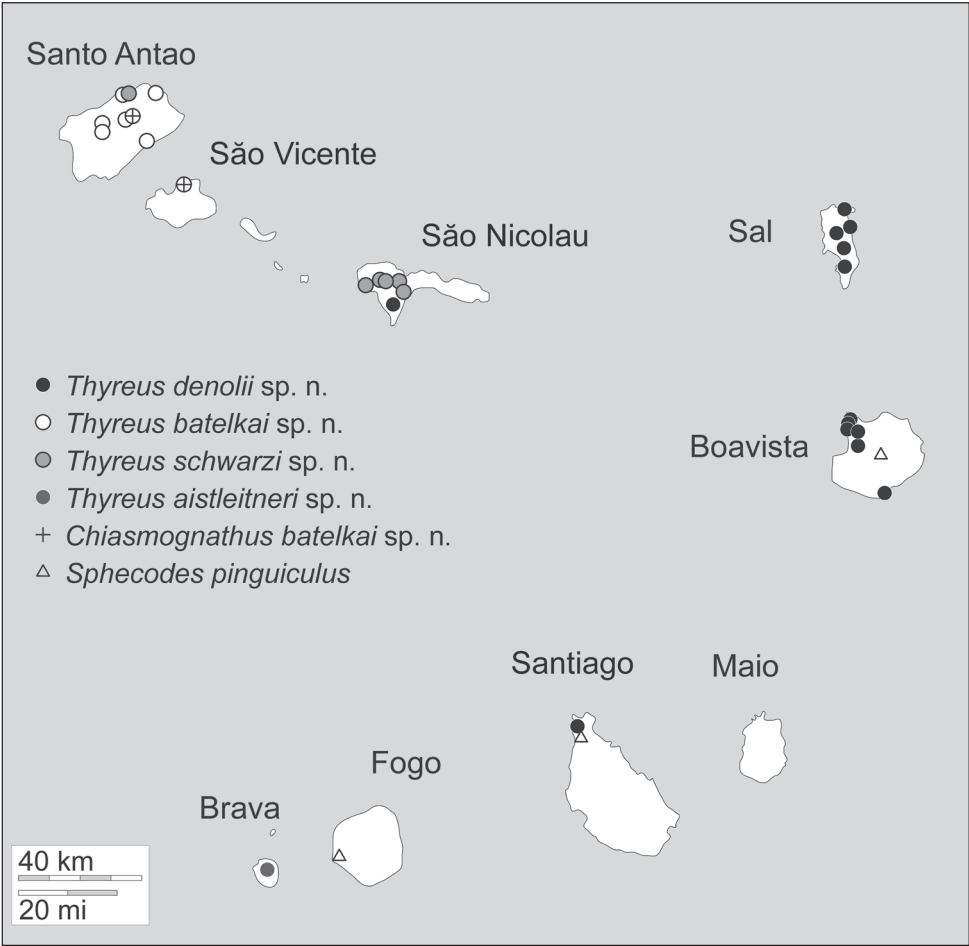
Morphological terminology for the descriptions follows that of Engel (2001) and Michener (2007) except we utilize the annotations developed by Liefstinck (1962, 1968) for patches of plumose white setae on the mesosoma (outlined below), while the format for the descriptions follow those used elsewhere for Melectini and Ammobatini, respectively (e.g., Liefstinck 1968; Rightmyer and Engel 2003; Engel 2009, 2010). Although Liefstinck’s abbreviations for patches may not be intuitive, we believe it is imperative to maintain continuity between this work and his monumental effort to revise a difficult group of bees. However, in order to avoid confusion when using the descriptions and keys we have also inserted full names of these patches in parentheticals. Liefstinck’s abbreviations are:

- als** anterolateral mesoscutal patch (paired); frequently transverse in shape and along anterior margin and often contiguous with *lpn*.
- deps** dorsal mesepisternal patch; large patch covering upper portion of mesepisternum.
- hypm** hypoepimeral area patch; patch situated under wing base and posterior to pronotal lobe and often contiguous with *deps*.
- lp** lateral propodeal patch; conspicuous patch on either side of propodeum and often concealing spiracle.
- lpn** lateral pronotal patch (paired); transverse and placed on each side of middle on dorsal-facing surface of pronotum and toward posterior lobe.
- mls** mediolateral mesoscutal patch (paired); often round and situated on either side and slightly anterior to center of mesoscutum and just posterior to caudal apex of *ms*.
- ms** median mesoscutal patch (unpaired); anterior longitudinal patch from anterior of mesoscutum and extending caudad beyond *als* along median line; often relatively diffuse.
- pls** posterolateral mesoscutal patch (paired); round or hook-shaped patch in line with *mls*, sometimes projecting anteriorly along lateral border to meet *plsa*.
- plsa** anterior posterolateral mesoscutal patch (paired); narrow, longitudinal patch along lateral border with tegula, often extending posteriorly to meet anterio-lateral projection of *pls*.
- ps** parascutellar patch (paired), situated within the axilla.
- s** mesoscutellar patch (paired), typically just posterior to apicolateral angle.
- t** regular patch, often posteriorly or along inner posterior angle.
- veps** ventral mesepisternal patch; smaller patch on ventral margin of mesepisternum.

Photomicrographs were prepared using a Canon EOS 7D digital camera attached to an Infinity K-2 long-distance microscope lens. Measurements were made using an ocular micrometer attached to an Olympus SZX-12 or MBS-10 stereomicroscope. Distributions of the species across the various islands are summarized in Table 2 and Map 1 (outline map of Cape Verde came from d-maps.com).

Table 2. Currently confirmed distributions of cuckoo bee species across the Cape Verde Islands (see also Map 1). All of the apid species are endemic, while *Sphecodes pingui culus* Pérez is widespread (Bogusch and Straka 2012). The distribution of *S. pingui culus* in the Cape Verde islands is specified here for the first time.

Taxon	Barlavento						Sotovento			
	Santo Antão	São Vicente	Santa Luzia	São Nicolau	Sal	Boa Vista	Maio	Santiago	Fogo	Brava
<i>Chiasmognathus batelkai</i>	X	X								
<i>Thyreus denolii</i>				X?	X	X		X		
<i>Thyreus batelkai</i>	X	X								
<i>Thyreus schwarzi</i>	X?			X						
<i>Thyreus aistleitneri</i>										X
<i>Sphecodes pingui culus</i>						X		X	X	
Totals	3	2		2	1	2		2	1	1



Map 1. Cape Verde islands with distribution of all cuckoo bee species.

Systematics

Subfamily Apinae Latreille

Tribe Melectini Westwood

Genus *Thyreus* Panzer

The genus *Thyreus* is the most diverse lineage of Melectini, encompassing at least 104 previously described species (e.g., Meyer 1921, 1922; Lieftinck 1958, 1959a, 1959b, 1962, 1968; Rozen 1969; Eardley 1991; Schwarz 1993). It is also one of the more challenging genera in the tribe, with considerable variation within species, many closely similar (perhaps even cryptic) species, and little in the way of comprehensive biological data. This difficulty in characterizing species based on unique and fixed traits is highlighted by the existing monographs which have attempted to clarify the taxonomy of this lineage. While assuredly monophyletic, no consistent concept of intergeneric relationships has been established, although the *scutellaris* group of species (excluding those species transferred to the genus *Thyreomelecta* Rightmyer and Engel, 2003) are likely relatively basal in the genus as their mesoscutellar structure appears more primitive relative to that of all other *Thyreus*. Where known, *Thyreus* principally are cleptoparasitic on *Amegilla* Friese, although a few records do exist of certain species victimizing *Anthophora* Latreille (subgenera *Heliophila* Klug, *Mystacanthophora* Brooks, and *Dasymegilla* Brooks) and *Eucera* Scopoli (subgenus *Synhalonia* Patton). The Cape Verde Islands *Thyreus* parasitize *Amegilla* (*atrocincta* species group; = *Micramegilla* Brooks), commonly found in association in the field (pers. obs.).

Thyreus denolii sp. n.

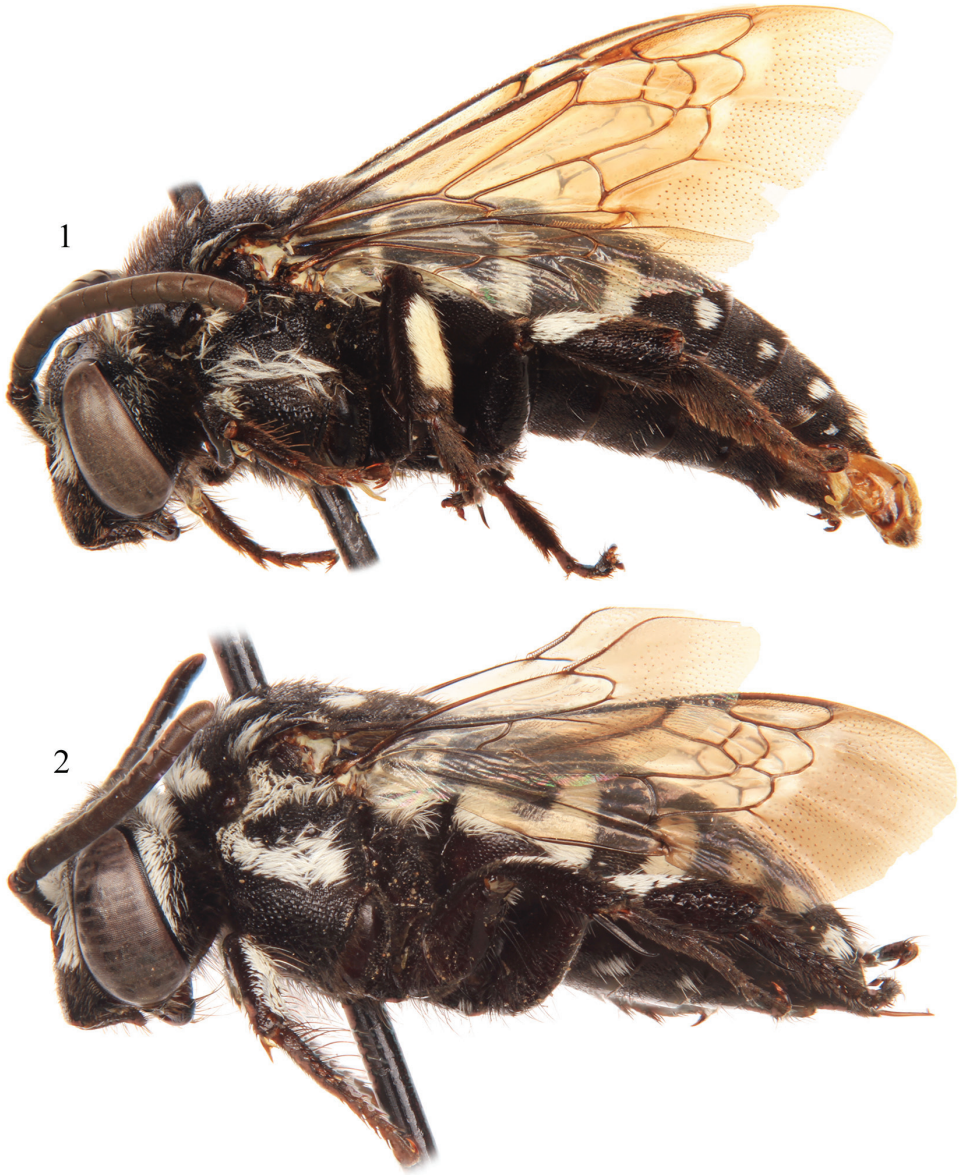
urn:lsid:zoobank.org:act:6436F526-A122-4B3F-B173-74EF3DF4948F

http://species-id.net/wiki/Thyreus_denolii

Figs 1–11

Holotype. ♂, Cape Verde Isl., Boavista, rock N of Sal Rei, 20.x.2009 [20 October 2009], J. Batelka & J. Straka lgt. (SEMC).

Paratypes. Boavista: 1♂, 2♀♀, Cabo Verde 00/41, Ilha de Boavista, Sal Rei–S, 10 m, 30.12.2000 [30 December 2000], leg. Aistleitner (EAFC); 4♂♂, Cabo Verde, Boavista, Costa de BoaEsperança, (NE Sal Rei), 50 m, 1.1.2001 [1 January 2001], leg. Aistleitner/ 46 (EAFC); 2♀♀, Cabo Verde 00/47, Ilha de Boavista, Ribeira de Rabil, 10–20 m, 2.1.2001 [2 January 2001], leg. Aistleitner (EAFC); 3♀♀, Cabo Verde 00/48, Ilha de Boavista centr., Estancia de Baixo, 60 m, 2.1.2001 [2 January 2001], leg. Aistleitner (EAFC); 1♂, 3♀♀, Cape Verde Isl., Boavista – Sal Rei, on the beach, 1.X.2009 [1 October 2009], J. Straka & J. Batelka lgt. (JSPC, FISC); 1♂, 1♀, Cape Verde Isl., Boavista – Sal Rei, dunes, sweeping, 19.X.2009 [19 October 2009], J. Batelka & J. Straka lgt. (JSPC); 3♂♂, Cape Verde Isl., Boavista – rock N of Sal Rei, 20.X.2009 [20 October 2009], J. Batelka & J. Straka lgt. (JSPC); 1♀, same data



Figures 1–2. Lateral habitus of *Thyreus denolii* sp. n. from Boavista. **1** Male **2** Female.

as holotype except: Sal Rei on the beach, 1.x.2009 [1 October 2009], J. Straka & J. Batelka lgt. (SEMC); **Sal:** 1♂, 4.11.1980 [4 November 1980], SAL, Straße Flughafen – Sta. Maria, n. v. Algodoeiro, Islas do Cabo Verde – 1980, H. Hölzel, W. Lobin, P. Ohm [collectors] (FISC); 1♂, 2♀♀, Cabo Verde 00/2, Ilha do Sal, Espargos, Boa Terra, 60 m, 28.11.2000 [28 November 2000], leg. Aistleitner (EAFIC); 4♂♂, 3♀♀, Cabo Verde 00/6, Ilha do Sal, Pedra Lume, Ostküste, 20–40 m, 29.11.2000 [29 November 2000], leg. Aistleitner (EAFIC); 1♂, Cabo Verde 00/7, Ilha do Sal, Mte. Grande–S,



Figures 3–4. Dorsal habitus of *Thyreus denolii* sp. n. from Boavista. **3** Male **4** Female.

70–170 m, 30.11.2000 [30 November 2000], leg. Aistleitner (EAFC); 1♂, the same as previous except 250 m (EAFC); 2♂♂, Cabo Verde 00/54, Ilha do Sal, Mte. Grande–E, 60 m, 9.1.2001 [9 January 2001], leg. Aistleitner (EAFC); 1♀, Cabo Verde, Ilha

do Sal, Pedra Lume, 19.3.2004 [19 March 2004], leg. Aistleitner (EAFC); 1♀, Cape Verde Isl., Sal – Murdeira, ribeira, 2.–3.XI.2011 [2–3 November 2011], 16°41'N, 22°55'W, J. Batelka & J. Straka lgt. (JSPC).

Additional material. **Sal:** 1♀, Cape Verde Isl., Sal – Monte Grande, 16.XI.2011 [16 November 2011], 20–350 m, 16°49'22"N, 22°54'22"W, J. Batelka & J. Straka lgt. [remnants of meso and metasoma] (JSPC); **Santiago:** 4♀♀; Ilhas do Cabo Verde, S. Tiago, Tarrafal, Triebe, Goh leg., 18.–20.10.79 [18–20 October 1979] (FISC, JSPC); 1♀, the same as previous except: Goh, Lobin leg., 10.79 [October 1979] (FISC); **São Nicolau:** 1♀, Ilhas do Cabo Verde, S. Nicolau, Goh, Lobin leg., 10.79 [October 1979] (FISC).

Diagnosis. *Thyreus denolii* is one of the most distinctive of the Cape Verde Island species of *Thyreus*. The species can be readily recognized in the male by the sixth metasomal tergum with lateral white patches of the same size as on the fourth and fifth terga (rarely with the white patches of the sixth tergum reduced, but when so, then the patches are also reduced on the preceding terga) (Figs 1, 3). The female has a combination of the ventral and ventrolateral parts of the mesepisternum with distinct shiny interspaces among the punctures; the mesoscutum with *pls*a (anterior posterolateral mesoscutal) present and bordering the anterior portion of the tegula, but not meeting *pls* (posterolateral mesoscutal) posteriorly (Fig. 4); the apical depression of the fifth metasomal tergum densely punctate medially and densely setose; and the fifth tergum with lateral white patches of the same size as those on the fourth and third terga (Figs 2, 4). Both sexes have the combination of the apicolateral corners of mesoscutellum weakly pointed, forming an angle of more than 40° (although more sharply pointed in the female than the male), and the mesoscutellum finely punctate, with punctures separated, at least on the disc, by 0.5–1 times a puncture width.

Description. ♂: Total body length 9.9 mm (7.5–9.9 mm); forewing length 7.4 mm (6.0–7.9 mm). Head wider than long (length 2.4 mm, width 3.0 mm); upper interorbital distance 1.8 mm; lower interorbital distance 1.3 mm. Intertegular distance 2.4 mm (2.0–2.6 mm); mesoscutellar posterior margin often sinuate, sometimes weakly so, such that apicolateral angle projects as a prominent, broad spine and with a defined median emargination [degree of this situation is variable and so some males have spines and median emargination less prominent, but margins from apicolateral corners to midpoint are never straight as is usual for species such as *T. hohmanni* Schwarz, typical *T. ramosus* (Lepeletier de Saint Fargeau), or several Asiatic species]. Inner anterior angle of metatibia not swollen or projecting into prominence or point between metatibial spurs (e.g., in some Palearctic species this area of metatibia is prominently developed: e.g., Lieftinck 1968). Apex of seventh metasomal tergum with apicolateral prominences distinct, truncate margin between straight, without medial emargination or swelling; male terminalia as in Figures 7–11.

Labrum with coarse, irregular, contiguous punctures except basolateral impunctate areas, such areas longer than wide and therefore ovoid in shape, basomedially with short V-shaped furrow; clypeus with small contiguous punctures, integument between (where evident) smooth; face as on clypeus except punctures slightly larger, nearly contiguous, and somewhat weaker on supraclypeal area; punctures weaker and

shallower on vertex and on ocellular area, with small impunctate area bordering lateral ocellus; punctures coarse, shallow, and nearly contiguous on gena and posterior area of postgena, anterior area of postgena smooth and impunctate. Pronotum with coarse, shallow, nearly contiguous punctures; mesoscutum with well-defined punctures separated by less than a puncture width, slightly more widely spaced around parasidal lines and medioposteriorly such that punctures are separated by about 0.5–2 times a puncture width, integument between punctures smooth and shining; mesoscutellum, including axilla, with punctures as on medioposterior section of mesoscutum except punctures separated by 0.5–1 times a puncture width; pleura with coarse, nearly contiguous punctures, integument between punctures (where evident) smooth and shining; hypoepimeral area with impunctate area bordering scrobe; propodeal lateral and posterior surfaces with coarse, shallow, ill-defined, nearly contiguous punctures. Metasoma with small punctures separated by less than a puncture width, punctures coarser, larger, and somewhat more poorly defined on more apical terga, integument between finely imbricate, apical margins narrowly impunctate and finely imbricate; sterna with similar punctation except those on discs of more basal sterna more widely spaced and becoming more poorly defined on more apical sterna.

Integument black except dark brown on tarsi, mouthparts, and apically on seventh metasomal tergum and on apical sterna. Wing membranes hyaline and slightly infumate, veins dark brown to black.

Pubescence generally fuscous to black over entire body except for presence of plumose white setae on face (Fig. 5), posterior of vertex, upper gena, outer surface of protibia, outer surface of mesotibia, outer basal surface of metatibia, and on mesosoma (using annotation system of Liefstinck 1962, 1968) as follows: *deps* (dorsal mesepisternal) and *lpn* (lateral pronotal) present; *als* (anterolateral mesoscutal) present but reduced, often faint; *ms* (median mesoscutal) present, although often reduced and faint; *mls* (mediolateral mesoscutal) present; *plsa* (anterior posterolateral mesoscutal) present along anterior half to two-thirds of border with tegula, not meeting *pls* (posterolateral mesoscutal) posteriorly; *t* (tegular) present and prominent posteriorly on tegula; *pls* (posterolateral mesoscutal) present, not extending laterally to meet *plsa* (anterior posterolateral mesoscutal); *ps* (parascutellar) and *s* (mesoscutellar) absent; *deps* (dorsal mesepisternal), *hypm* (hypoepimeral area), and *lp* (lateral propodeal) present, *veps* (ventral mesepisternal) absent (Figs 1, 3). Mesoscutellum with dense patch of long, plumose, white setae extending posteriorly from undersurface of mesoscutellum medially, patch wide but not reaching to apicolateral corners. Metasomal terga with prominent patches of appressed, plumose white setae as follows: first metasomal tergum with large, L-shaped patches laterally; second metasomal tergum with lateral patch transverse, slightly wider than twice as long, never L-shaped and without rounded secondary anterior patch; third through sixth metasomal terga with more or less transverse to rounded lateral patches (Figs 1, 3).

♀: As described for the male except in usual gender differences and as follows: Total body length 8.1–10.6 mm; forewing length 6.4–7.4 mm. Head wider than long (length 2.4 mm, width 3.0 mm); upper interorbital distance 1.9 mm; lower interorbi-



Figures 5–6. Facial aspect of *Thyreus denolii* sp. n. from Boavista (facial views for the various species do not really vary and so only those for *T. denolii* are presented). **5** Male **6** Female.

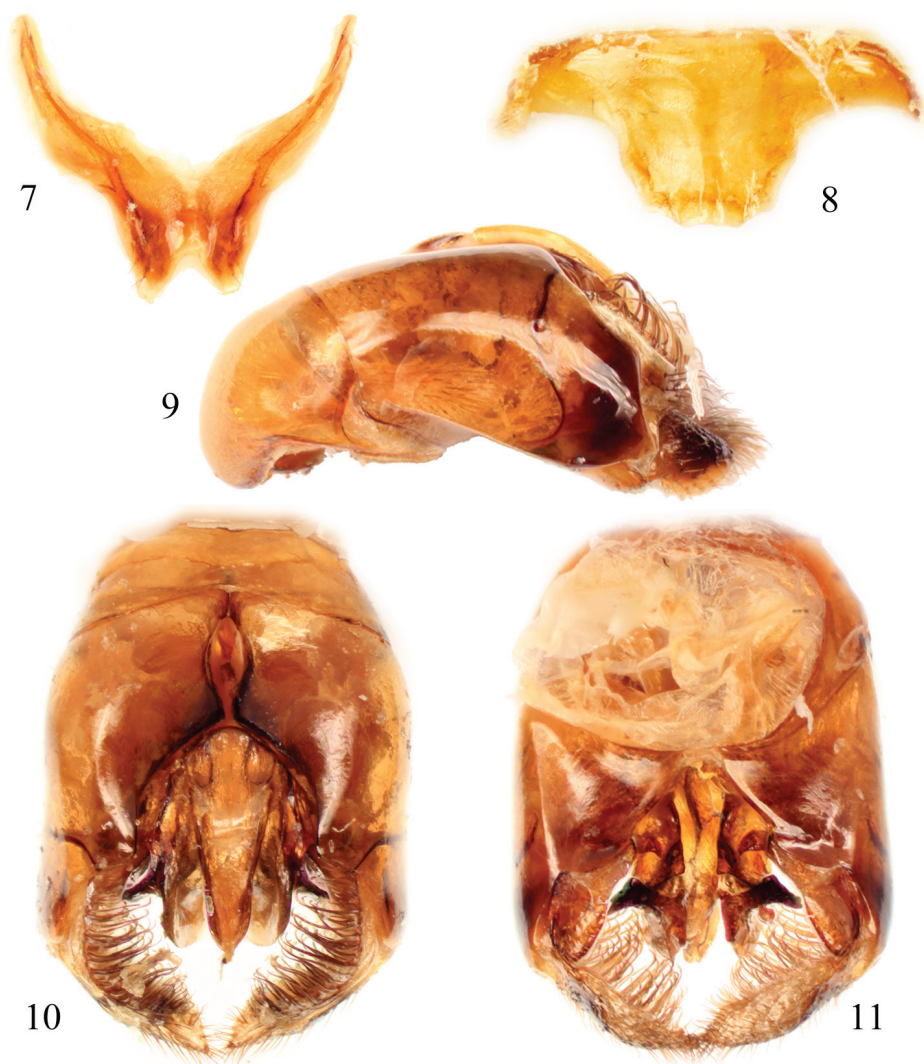
tal distance 1.3 mm (Fig. 6). Intertegular distance 2.1–2.5 mm; mesoscutellar posterior margin as in male but sometimes sinuate margin weaker and apicolateral angle not forming as prominent a spine. Apical depression of fifth tergum densely punctate and setose. Pygidial plate relatively narrow, margins converging apically, largely straight, apex narrowly rounded, surface imbricate, basal half with shallow, coarse punctures.

Clypeus with small punctures more widely spaced than in male, separated by less than a puncture width, punctures variable in size placed apically, but rather uniform medially, integument between smooth. Mesoscutum with well-defined punctures separated by less than a puncture width anteriorly and laterally, slightly more widely spaced on disc and posteriorly, there separated by 0.5–1.5 times a puncture width; mesoscutellum with punctures separated by less than a puncture width, less frequently separated by as much as a puncture width, axilla with punctures separated by less than a puncture width.

Integument and pubescence as in male except dark brown on pygidial plate; second through fifth metasomal terga with more or less transverse to rounded lateral patches (Figs 2, 4).

Etymology. The specific epithet is a patronym honoring António de Noli (ca. 1415–d. ?), a Genoese navigator who, exiled from his homeland and working on behalf of Portugal, discovered the Cape Verde Islands around 1456.

Comments. The five females collected from Santiago are not designated as part of the type series. While they most closely agree with this species the shape of the pygidial plate is slightly different and this series could possibly represent a separate species. However, given that this is the only fixed difference we can find at this time and that we lack males from Santiago, we have tentatively assigned these individuals to *T. denolii* pending the discovery of additional material. Analogously, a single female from S. Nicolau that is clearly of *T. denolii* is also not designated as part of the type series. This might be a mislabeled specimen, a normal part of *T. denolii*'s distribution, or even a different species. This particular female specimen of *T. denolii* is unique in its L-shaped white patch on the second tergum. More material and collecting are needed so as to permit a more accurate characterization of the distribution and possible variation within the species.



Figures 7–11. Male terminalia of *Thyreus denolii* sp. n. **7** Seventh metasomal sternum **8** Eighth sternum **9** Genital capsule, lateral aspect **10** Genital capsule, dorsal view **11** Genital capsule, ventral view.

***Thyreus batelkai* sp. n.**

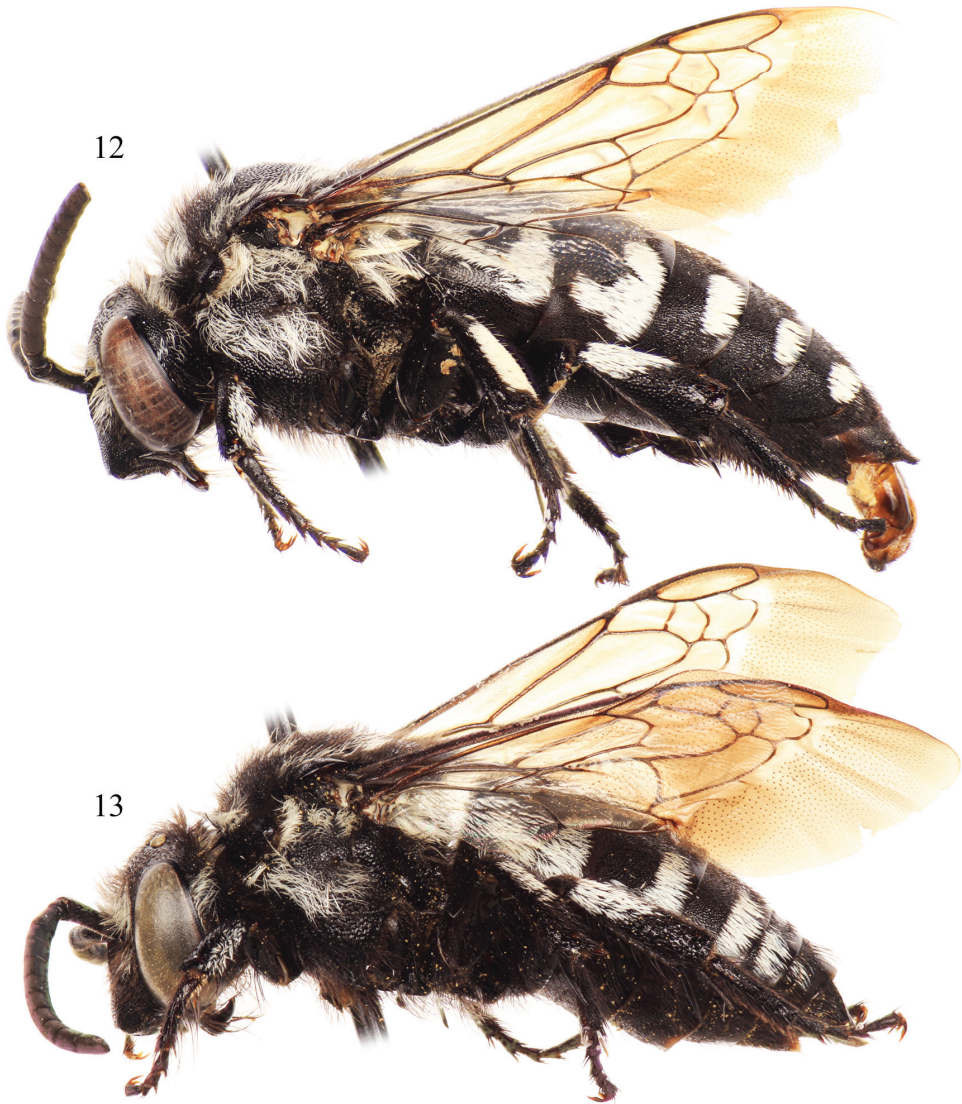
urn:lsid:zoobank.org:act:97D31AFF-AFE9-4234-8B7D-785D2E7B8020

http://species-id.net/wiki/Thyreus_batelkai

Figs 12–20

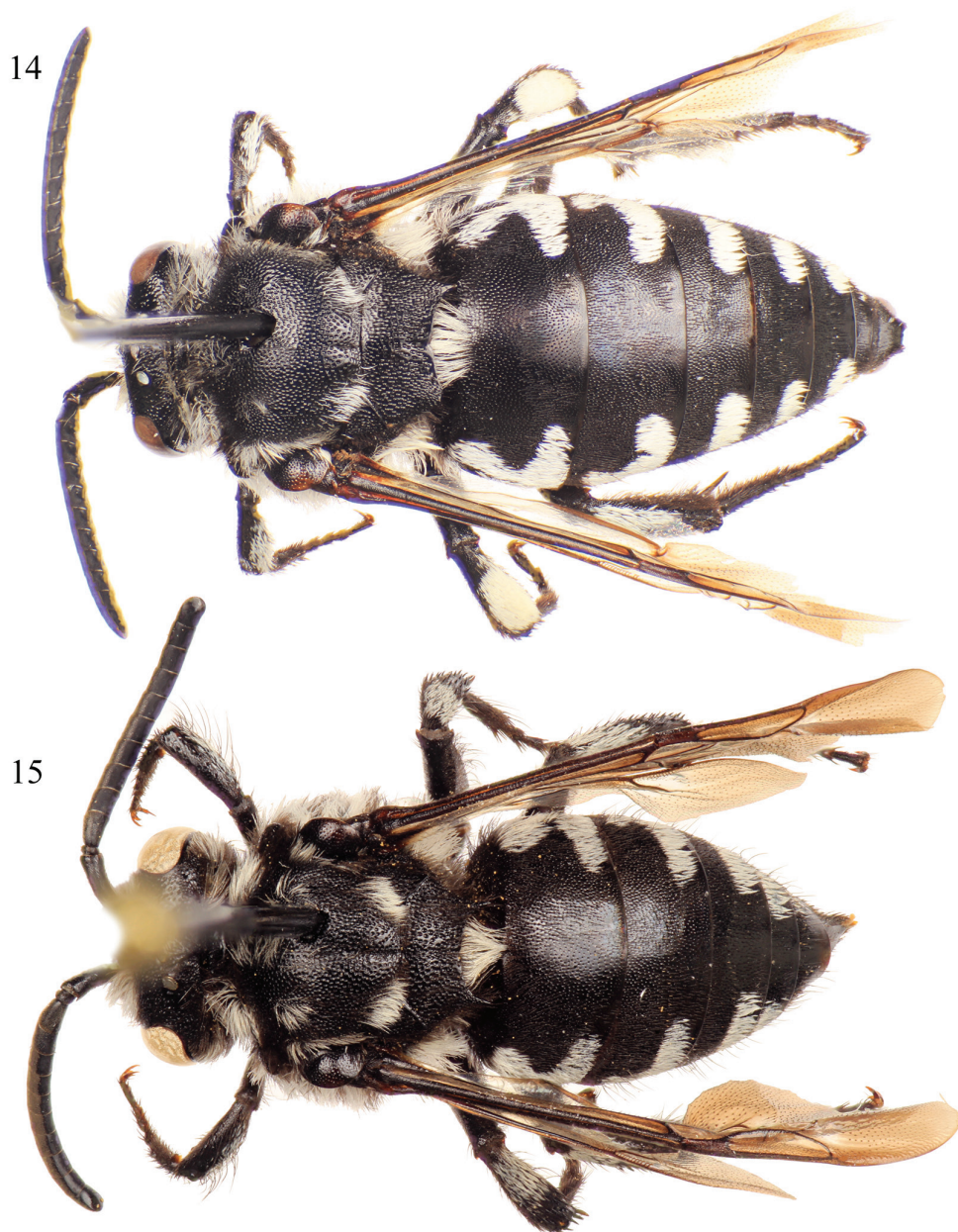
Holotype. ♂, Cape Verde Isl., Santo Antao, 1382 m, Espongeiro, 13.x.2009 [13 October 2009], 17°06'17"N, 25°05'21"W, J. Straka & J. Batelka lgt. (SEMC).

Paratypes. **Santo Antão:** 1♀, 21.11.1980 [21 November 1980], SANTO ANTÃO, 400–1000 supra Porto Novo, Islas do Cabo Verde – 1980, H. Hölzel, W. Lobin, P.



Figures 12–13. Lateral habitus of *Thyreus batelkai* sp. n. from Santo Antão. **12** Male **13** Female.

Ohm [collectors] (FISC); 1♀, Cabo Verde, Santo Antão, 5.01.99 [5 January 1999], Ribeira Grande, Orgãos, 50–200 m, leg. Aistleitner (EAFC); 1♀, Cabo Verde 00/10, Ilha d. S. Antão, Ribeira Grande, 2.12.2000 [2 December 2000], leg. Aistleitner (EAFC); 2♀♀, Cabo Verde 00/21, Ilha d. S. Antão, Cruzinha da Garça, 50 m, 7.12.2000 [7 December 2000], leg. Aistleitner (EAFC); 5♀♀, Cabo Verde 00/23, Ilha de S. Antão, Cruzinha da Garça, 10–50 m, 9.12.2000 [9 December 2000], leg. Aistleitner (EAFC); 1♂, 2♀♀, Cabo Verde 00/24, Ilha de S. Antão centr., Lagoa-E, 1150–1300 m, 10.12.2000 [10 December 2000], leg. Aistleitner (EAFC); 2♀♀, 1♂, Cape Verde Isl., Santo Antao, 1382 m, Espongeiro, 13.X.2009 [13 October 2009],



Figures 14–15. Dorsal habitus of *Thyreus batelkai* sp. n. from Santo Antão. **14** Male **15** Female.

17°06'17"N, 25°05'21"W, J. Straka & J. Batelka lgt. (JSPC); 2♀♀, 1♂, same data as previous except 12.–13.X.2009 [12–13 October 2009], 17°06'N, 25°05'W (JSPC, SEMC); 8♀♀, 4♂♂, Cape Verde Isl., Santo Antao – Selada de Alto Mira – Cirio, 4.–5.XI.2011 [4–5 November 2011], 17°04'N, 25°13'W, J. Straka & J. Batelka lgt. (JSPC, FISC); 2♀, 1♂, Cape Verde Isl., Santo Antao – Curral das Vacas – Bordeira

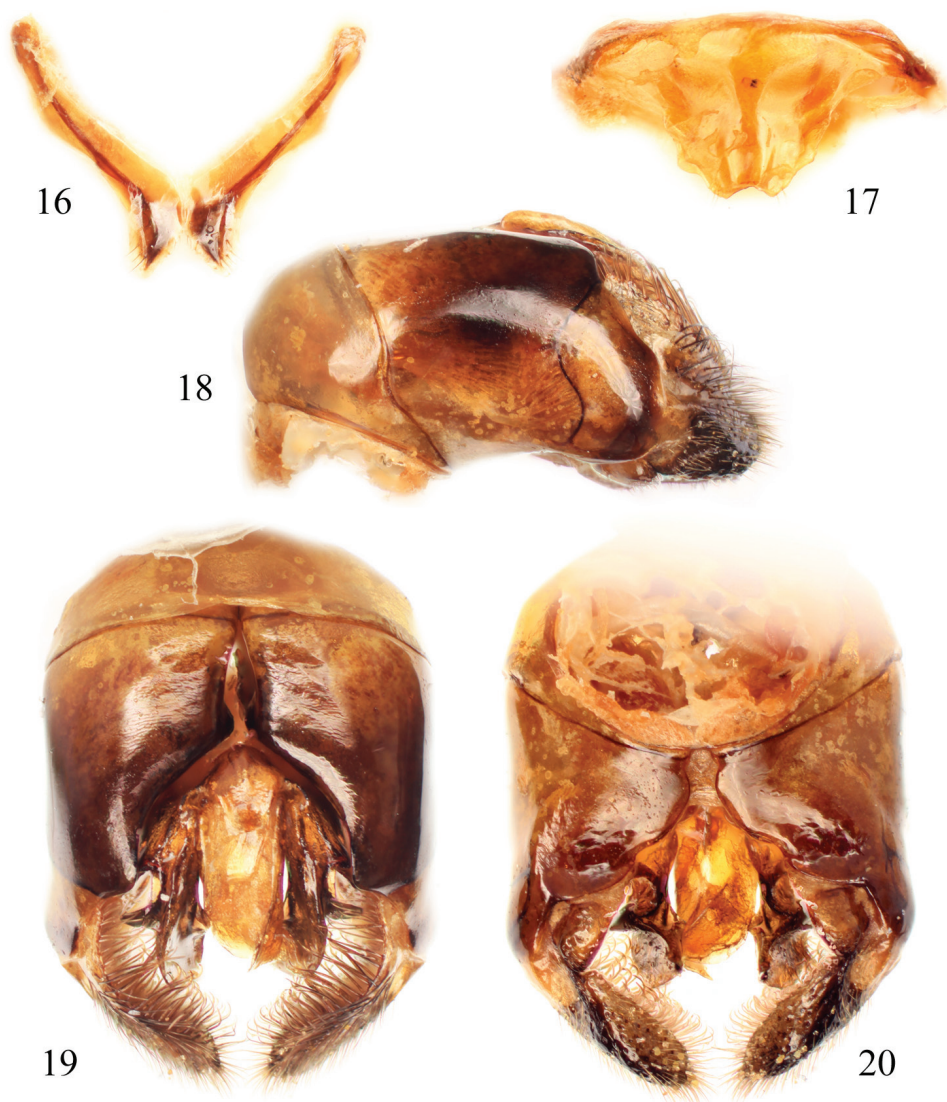
de Norte, 6.XI.2011 [6 November 2011], 17°02'N, 25°14'W, J. Batelka & J. Straka lgt. (JSPC); 1♂, Cape Verde Isl., Santo Antao – black dunes 3 km W of Porto Novo, 7.XI.2011 [7 November 2011], 17°0'47"N, 25°06'30.84"W, J. Straka & J. Batelka lgt. (JSPC); 1♀, Santo Antao, Selada de Alto Mira – Cirio, 4–5.xi.2011 [4–5 November 2011], 17°04'N, 25°13'W, J. Straka & J. Batelka lgt. (SEMC); **São Vicente:** 6♂♂, 10♀♀, Cabo Verde 00/25, Ilha de S. Vicente, Calhau – Baia d. Gatas, -5 m, 13.12.2000 [13 December 2000], leg. Aistleitner (EAFC).

Diagnosis. *Thyreus batelkai* can be distinguished in the male by the combination of the lateral white patches of the sixth metasomal tergum greatly reduced, especially in comparison to the patches on the fourth and fifth terga, and the second tergum with the lateral white patch L-shaped (as on the first tergum) or at least with a smaller anterior patch (Fig. 14); while the female can be recognized by the mesoscutum with *plsa* (anterior posterolateral mesoscutal) present anterior to and along the border with the tegula, extending posteriorly and meeting, or less frequently almost meeting, *pls* (posterolateral mesoscutal); the second metasomal tergum with the lateral white patch L-shaped (as on the first tergum) or at least with a smaller anterior patch (Figs 12, 14); and the apical depression of the fifth tergum bare medially, rarely with a few punctures with short setae. In both sexes the mesoscutum has coarse punctures throughout; the mesoscutellum is coarsely punctate, with punctures dense and nearly contiguous; the apicolateral corners of the mesoscutellum are prominently and sharply pointed, forming an angle of less than 40° (Figs 14, 15); and all of the white, anterior mesoscutal patches are well developed.

Description. As described for *T. denolii* (*vide supra*) except as follows: ♂: Total body length 13.7 mm (7.9–13.7 mm); forewing length 9.6 mm (6.5–10.6 mm). Head wider than long (length 2.7 mm, width 3.5 mm); upper interorbital distance 2.2 mm; lower interorbital distance 1.6 mm. Intertegular distance 3.1 mm (2.3–3.4 mm); mesoscutellar posterior margin weakly sinuate, with apicolateral angle projecting as a prominent spine, with a defined median emargination (Fig. 15). Apex of seventh metasomal tergum with apicolateral prominences distinct, margin between frequently broadly U-shaped, weakly concave, without medial emargination or swelling; male terminalia as in Figures 16–20.

Mesoscutum with well-defined, coarse, contiguous to nearly contiguous punctures; mesoscutellum, including axilla, as on mesoscutum. Pleura with coarse, contiguous punctures; hypoepimeral area as on remainder of pleura, without impunctate area bordering scrobe.

White patches on mesosoma as follows: *deps* (dorsal mesepisternal), *lpn* (lateral pronotal), and *als* (anterolateral mesoscutal) present; *ms* (median mesoscutal) present, often extending to posterior tangent of *mls* (mediolateral mesoscutal); *mls* (mediolateral mesoscutal) present; *plsa* (anterior posterolateral mesoscutal) present anterior to and along border with tegula, extending posteriorly and meeting, or less frequently almost meeting, *pls* (posterolateral mesoscutal); *t* (tegular) present posteriorly on tegula; *pls* (posterolateral mesoscutal) present; *ps* (parascutellar) and *s* (mesoscutellar) absent; *deps* (dorsal mesepisternal), *hypm* (hypoepimeral area), and *lp* (lateral propodeal) present, *veps* (ven-



Figures 16–20. Male terminalia of *Thyreus batelkai* sp. n. **16** Seventh metasomal sternum **17** Eighth sternum **18** Genital capsule, lateral aspect **19** Genital capsule, dorsal view **20** Genital capsule, ventral view.

tral mesepisternal) absent (Figs 12, 14). Metasomal terga with prominent patches of appressed, plumose white setae as follows: first metasomal tergum with large, L-shaped patches laterally; second metasomal tergum with large, L-shaped patches laterally as on first tergum, infrequently L-shape is incomplete with secondary rounded secondary anterior patch almost connecting posterior transverse patch; third through fifth metasomal terga with more or less transverse to rounded lateral patches (Figs 12, 14).

♀: As described for the male except in usual gender differences and as follows: Total body length 7.4–13.6 mm; forewing length 5.7–10.4 mm. Head wider than long

(length 3.2 mm, width 3.9 mm); upper interorbital distance 2.3 mm; lower interorbital distance 1.8 mm. Intertegular distance 1.7–3.4 mm; mesoscutellar posterior margin forming a more gently, broad curve that is more straight medially between apicolateral angles, apicolateral angles forming a prominent spine, medially not to faintly emarginate. Apical depression of fifth tergum impunctate medially. Pygidial plate relatively narrow, margins converging apically, largely straight, apex narrowly rounded, surface imbricate except apicolaterally with smooth areas, basal half with shallow, coarse punctures.

Clypeus with small punctures separated by less than a puncture width, but with variable punctures in size apically and more sparsely punctate than in middle, some interspaces among punctures about as large as a puncture width, integument between smooth.

Integument and pubescence as in male except dark brown on pygidial plate; third through fifth metasomal terga with more or less transverse to rounded lateral patches (Figs 13, 15).

Etymology. The specific epithet is a patronym honoring Jan Batelka, a prominent collector of the new species, authority on the systematics of beetles, and close friend.

***Thyreus schwarzi* sp. n.**

urn:lsid:zoobank.org:act:92D8F800-D36A-4B7E-AADE-BA3F770B96DD

http://species-id.net/wiki/Thyreus_schwarzi

Figs 21–29

Holotype. ♂, Isl., Cabo Verde, S. Nicolau, 1.XII.80 [1 December 1980], Ribeiro Brava, Islas do Cabo Verde - 1980, H. Hölzel, W. Lobin, P. Ohm [collectors] (FISC).

Paratypes. **São Nicolau:** 1♂, same data as holotype (FISC); 1♀, Ilhas do Cabo Verde, S. Nicolau, Lobin leg. (FISC); 1♀, Cabo Verde 00/31, Ilha de S. Nicolau, Ribeira Brava–W, 100–150 m, 20.12.2000 [20 December 2000], leg. Aistleitner (EAFC); 3♂♂, Cabo Verde 00/34, Ilha de S. Nicolau, Preguiça–N, 70–100 m, 21.12.2000 [21 December 2000], leg. Aistleitner (EAFC); 4♂♂, Cabo Verde 00/36, Ilha de S. Nicolau, Monte Gordo, 12–1300 m, 22.12.2000 [22 December 2000], leg. Aistleitner (EAFC); 1♂, Cape Verde Isl., Sao Nicolau W, Barril, 11.XI.2011 [11 November 2011], 16°35'24"N, 24°23'84"W, J. Straka & J. Batelka lgt. (JSPC); 1♀, Sao Nicolau, W, south of Cachao, Cha de Caldeira, 12.xi.2011, 16°36'39"N, 24°19'58"W, J. Batelka & J. Straka lgt. (SEMC).

Additional material. **Santo Antão:** 1♀, Cabo Verde 00/21, Ilha d. S. Antão, Cruzinha da Garça, 50 m, 7.12.2000 [7 December 2000], leg. Aistleitner (EAFC).

Diagnosis. Males of *T. schwarzi* can be recognized by the following combination of characters: white anterior mesoscutal patches, especially *ms* (median mesoscutal) and *mls* (mediolateral mesoscutal), strongly reduced to missing (Fig. 23); second metasomal tergum with lateral patch wider than long, without anterior secondary patch and never L-shaped (Fig. 23), but rarely with a few white setae in this area; and sixth tergum with lateral white patches greatly reduced, especially in comparison to patches on the fourth and fifth terga. Females can be characterized by the following combination



Figures 21–22. Lateral habitus of *Thyreus schwarzi* sp. n. from São Nicolau. **21** Male **22** Female.

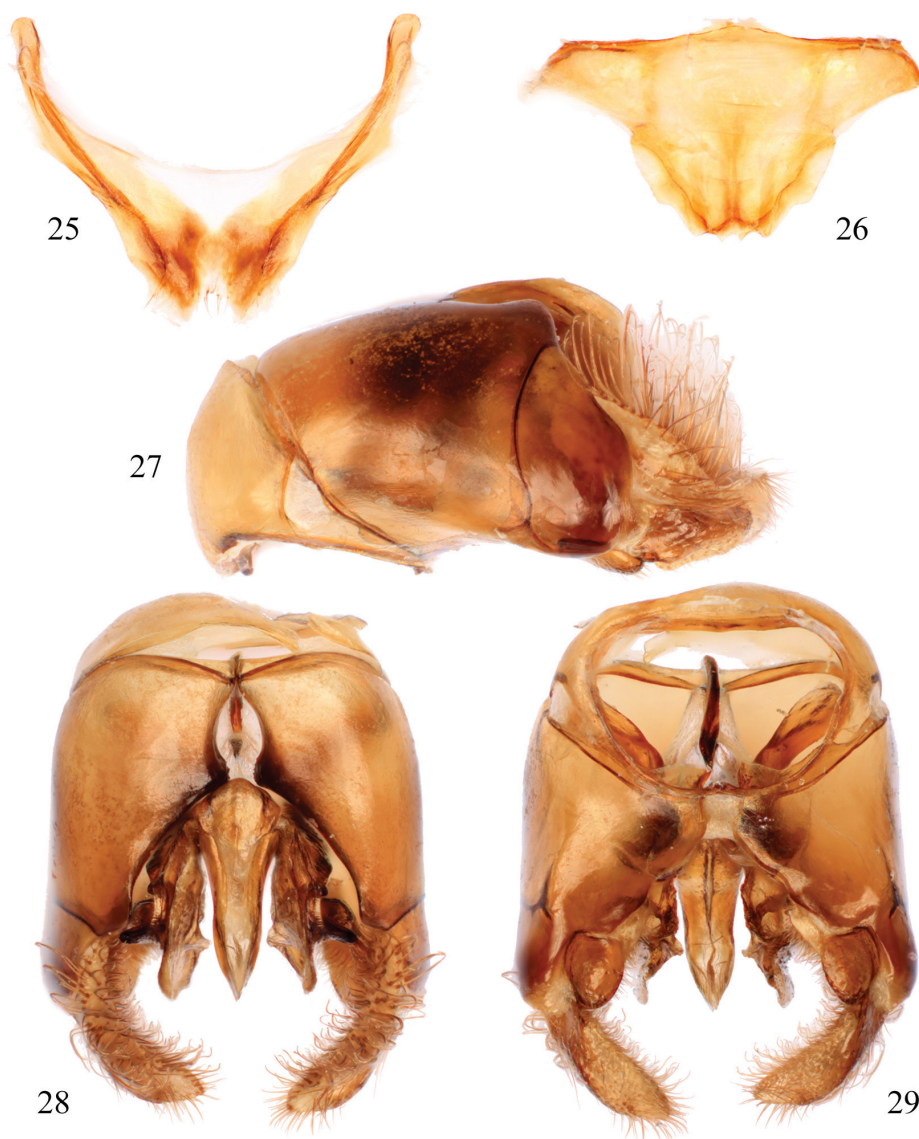
of traits: white anterior mesoscutal patches, especially paired *mls* (mediolateral mesoscutal), greatly reduced to a few short setae (Fig. 24); mesoscutum with *plsa* (anterior posterolateral mesoscutal) present anterior to and along border with tegula, extending posteriorly and meeting, or less frequently almost meeting, *pls* (posterolateral mesoscutal) (Fig. 24); second metasomal tergum with lateral patch wider than long, without anterior secondary patch and never L-shaped (Fig. 24), but rarely with a few white setae in this area; and apical depression of fifth tergum with several distinct seta-bearing punctures. Both males and females have the apicolateral corners of the mesoscutellum prominently and sharply pointed, forming an angle of less than 40° (Figs 23, 24)

Description. As described for *T. denolii* (*vide supra*) except as follows: ♂: Total body length 12.8 mm (8.5–14.0 mm); forewing length 10.4 mm (6.7–10.5 mm). Head wider than long (length 3.1 mm, width 3.7 mm); upper interorbital distance 2.3 mm; lower interorbital distance 1.7 mm. Intertegular distance 3.4 mm (2.1–3.5



Figures 23–24. Dorsal habitus of *Thyreus schwarzi* sp. n. from São Nicolau. **23** Male **24** Female.

mm); mesoscutellar posterior margin faintly sinuate, with apicolateral angle projecting as slightly prominent spine, with median emargination. Apex of seventh metasomal tergum with apicolateral prominences distinct, truncate margin between straight, without medial emargination or swelling; male terminalia as in figures 25–29.



Figures 25–29. Male terminalia of *Thyreus schwarzi* sp. n. **25** Seventh metasomal sternum **26** Eighth sternum **27** Genital capsule, lateral aspect **28** Genital capsule, dorsal view **29** Genital capsule, ventral view.

Mesoscutum with well-defined punctures separated by much less than a puncture width, punctures mediopically more spaced, separated by about 0.5–1 times a puncture width but more often less than a puncture width, integument between punctures smooth and shining; mesoscutellum, including axilla, with punctures separated by less than a puncture width, those laterally nearly contiguous to contiguous.

White patches on mesosoma as follows: *deps* (dorsal mesepisternal) and *lpn* (lateral pronotal) present; *als* (anterolateral mesoscutal) present but reduced, often faint; *ms*

(median mesoscutal) faint to absent; *mls* (mediolateral mesoscutal) present to faint; *plsa* (anterior posterolateral mesoscutal) present anterior to and along border with tegula, extending posteriorly and meeting, or less frequently almost meeting, *pls* (posterolateral mesoscutal); *t* (tegular) present and prominent posteriorly on tegula; *pls* (posterolateral mesoscutal) present; *ps* (parascutellar) and *s* (mesoscutellar) absent; *deps* (dorsal mesepisternal), *hypm* (hypoepimeral area), and *lp* (lateral propodeal) present, *veps* (ventral mesepisternal) absent (Figs 21, 23). Metasomal terga with prominent patches of appressed, plumose white setae as follows: first metasomal tergum with large, L-shaped patches laterally; second metasomal tergum with lateral patch transverse, slightly wider than twice as long, never L-shaped and without rounded secondary anterior patch; third through fifth metasomal terga with more or less transverse to rounded lateral patches (Figs 21, 23).

♀: As described for the male except in usual gender differences and as follows: Total body length 11.8–13.1 mm; forewing length 9.4–10.2 mm. Head wider than long (length 3.0 mm, width 3.8 mm); upper interorbital distance 2.3 mm; lower interorbital distance 1.7 mm. Intertergular distance 2.8–3.3 mm; mesoscutellar posterior margin as in male but sinuate margin stronger. Apical depression of fifth tergum sparsely but distinctly punctate and setose. Pygidial plate relatively broad, margins converging apically, largely straight, apex narrowly rounded, surface imbricate, basal half with shallow, coarse punctures.

Mesoscutum with well-defined punctures separated by much less than a puncture width, punctures mediopically slightly more spaced but still separated by less than a puncture width; mesoscutellum, including axilla, with punctures separated by less than a puncture width.

Integument and pubescence as in male except dark brown on pygidial plate; second through fourth metasomal terga with more or less transverse to rounded lateral patches (Figs 22, 24).

Etymology. The specific epithet is a patronym honoring Dr. Maximilian Schwarz, a leading authority on the systematics of cuckoo bees and a dear colleague.

Comments. A single female collected from Santo Antão is not designated as part of the type series since the specimen may be mislabeled or a rare case of introduction to a different island.

Thyreus aistleitneri sp. n.

urn:lsid:zoobank.org:act:B992FB5F-C606-4CA7-BE75-5021D4AE36F7

http://species-id.net/wiki/Thyreus_aistleitneri

Figs 30–34

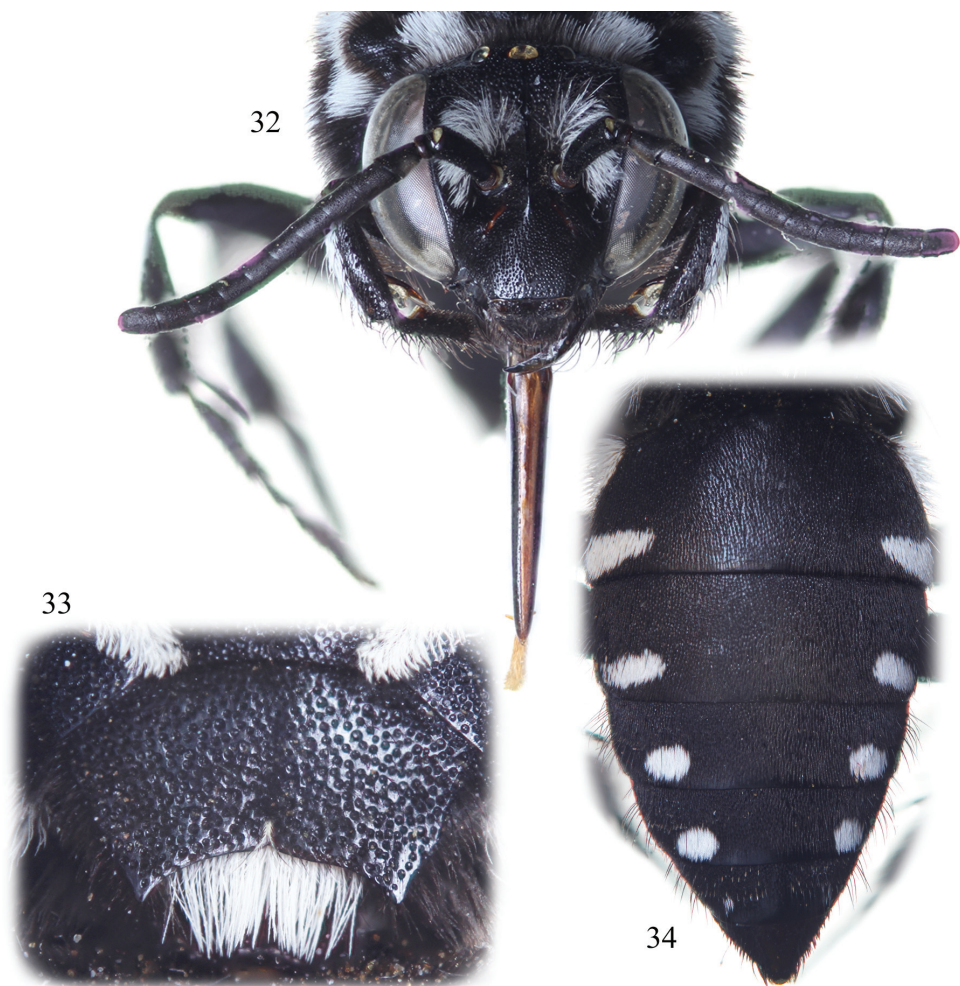
Holotype. ♀, Cabo Verde, Brava, Nova Sintra, Mte. Nha Preta, 700–880 m, 25.01.01 [25 January 2001], leg. Aistleitner (SEMC).

Diagnosis. The new species can be recognized by the following combination of features: mesoscutum with *plsa* (anterior posterolateral mesoscutal) present and bor-



Figures 30–31. Female of *Thyreus aistleitneri* sp. n. from Brava. **30** Lateral habitus **31** Dorsal habitus.

dering anterior portion of tegula, not meeting *pls* (posterolateral mesoscutal) posteriorly (Fig. 31); mesoscutellum coarsely punctate, with punctures dense, separated, at least on disc, by less than 0.5 times a puncture width; apicolateral corners of mes-



Figures 32–34. Female of *Thyreus aistleitneri* sp. n. from Brava. **32** Facial aspect **33** Detail of mesoscutellum **34** Detail of metasoma in dorsal view.

oscutellum weakly pointed, forming angle of more than 40° (Fig. 33); ventral and ventrolateral pleura with distinct shiny interspaces among punctures; apical depression of fifth metasomal tergum with a few isolated punctures medially; fifth tergum with lateral white patches reduced, especially in comparison to patches on fourth and third tergum (Figs 30, 31, 34).

Description. As described for *T. denolii* (*vide supra*) except as follows: ♀: Total body length 11.3 mm; forewing length 8.3 mm. Head wider than long (length 2.9 mm, width 3.5 mm) (Fig. 32); upper interorbital distance 2.1 mm; lower interorbital distance 1.55 mm. Intertegular distance 2.7 mm; mesoscutellar posterior margin faintly sinuate, apicolateral angle projects as a prominent, broad spine and with a defined median emargination (Figs 31, 33). Apical depression of fifth tergum sparsely,

but distinctly, punctate and setose. Pygidial plate relatively narrow, margins converging apically, slightly sinuate, apex narrowly rounded, surface imbricate, basal half with shallow, coarse punctures.

Mesoscutum with well-defined punctures separated by much less than a puncture width, punctures mediopically more spaced, separated by about 0.5–1 times a puncture width but more often less than a puncture width, integument between punctures smooth and shining; mesoscutellum, including axilla, with punctures separated by less than a puncture width, those laterally nearly contiguous (Fig. 33).

White patches on mesosoma as follows: *deps* (dorsal mesepisternal) and *lpn* (lateral pronotal) present; *als* (anterolateral mesoscutal) present but reduced; *ms* (median mesoscutal) faint; *mls* (mediolateral mesoscutal) present; *plsa* (anterior posterolateral mesoscutal) present along anterior half of border with tegula, not meeting *pls* (posterolateral mesoscutal) posteriorly; *t* (tegular) present and prominent posteriorly on tegula; *pls* (posterolateral mesoscutal) present, not extending laterally to meet *plsa* (anterior posterolateral mesoscutal); *ps* (parascutellar) and *s* (mesoscutellar) absent; *deps* (dorsal mesepisternal), *hypm* (hypopimeral area), and *lp* (lateral propodeal) present, *veps* (ventral mesepisternal) absent (Fig. 31). Pleural white spot reduced to two separate spots (Fig. 30). Metasomal terga with prominent patches of appressed, plumose white setae as follows: first metasomal tergum with L-shaped patch laterally interrupted in middle and thus divided into two spots, one transverse at apicolateral margin and one triangular on tergal side; second metasomal tergum with reduced lateral patch transverse, slightly wider than twice as long, without rounded secondary anterior patch; third and fourth metasomal terga with rounded lateral patches; fifth metasomal tergum with lateral spot reduced to a few setae (Figs 30, 31, 34); pygidial plate with dark brown setae.

♂: Unknown.

Etymology. The specific epithet is a patronym honoring Eyjolf Aistleitner, collector of the new species among many fine insects, and authority on the systematics of Lepidoptera.

Key to the Species of *Thyreus* of the Cape Verde Islands

- | | | |
|---|--|---------------------------------|
| 1 | Males..... | 2 |
| – | Females..... | 4 |
| 2 | Sixth metasomal tergum with lateral white patches of the same size as on fourth and fifth terga; mesoscutellum finely punctate, with punctures separated, at least on disc, by 0.5–1 times a puncture width; apicolateral corners of mesoscutellum weakly pointed (angle more than 40°); metasoma densely punctate, punctures reach almost the end of metasomal terga (Boavista, Sal, Santiago*, S. Nicolau**). | <i>T. denolii</i> sp. n. |
| – | Sixth metasomal tergum with lateral white patches greatly reduced, especially in comparison to patches on fourth and fifth tergum; mesoscutellum more coarsely punctate, with punctures dense, nearly contiguous; apicolateral cor- | |

- ners of mesoscutellum more prominently and sharply pointed (angle less than 40°); metasoma more sparsely punctate, punctures separated from margins...**3**
- 3 Second metasomal tergum with lateral white patch L-shaped (as on first tergum) or at least with smaller anterior patch (Fig. 14); mesoscutum with coarse punctures throughout; all white anterior mesoscutal patches well developed (S. Antão) ***T. batelkai* sp. n.**
- Second metasomal tergum with lateral patch wider than long, without anterior secondary patch and never L-shaped (Fig. 23), but rarely with few white setae in this area; mesoscutellum with finer punctures at least basomedially; white anterior mesoscutal patches, especially *ms* (median mesoscutal) and *mls* (mediolateral mesoscutal), strongly reduced to missing (Fig. 23) (S. Nicolau) ***T. schwarzi* sp. n.**
- 4 Apicolateral corners of mesoscutellum weakly pointed (angle more than 40°) (e.g., Fig. 33); mesoscutellum finely punctate, with punctures separated, at least on disc, by 0.5–1 times a puncture width (except *T. aistleitneri*); ventral and ventrolateral portions of pleura with distinct shiny interspaces among punctures; mesoscutum with *plsa* (anterior posterolateral mesoscutal) present and bordering anterior portion of tegula, not meeting *pls* (posterolateral mesoscutal) posteriorly (e.g., Figs 4, 31) **5**
- Apicolateral corners of mesoscutellum sharply pointed (angle less than 40°) (Figs 15, 24); mesoscutellum more coarsely punctate, with punctures dense, nearly contiguous; pleura ventrally and ventrolaterally coarsely punctate, interspaces among most punctures indistinct (smallest specimens sometimes with sparsely punctate pleura); mesoscutum with *plsa* (anterior posterolateral mesoscutal) present anterior to and along border with tegula, extending posteriorly and meeting, or less frequently almost meeting, *pls* (posterolateral mesoscutal) (e.g., Figs 15, 24) **6**
- 5 Apical depression of fifth tergum densely punctate medially and densely setose; fifth metasomal tergum with lateral white patches of same size as on fourth and third terga (Fig. 4) (rarely white patches on fifth tergum reduced, but then reduced also on preceding terga); mesoscutellum finely punctate, with punctures separated, at least on disc, by 0.5–1 times a puncture width (Boavista, Sal, Santiago*, S. Nicolau**) ***T. denolii* sp. n.**
- Apical depression of fifth tergum with a few isolated punctures medially; fifth metasomal tergum with lateral white patches reduced, especially in comparison to patches on fourth and third terga (Figs 30, 31, 34); mesoscutellum more coarsely punctate, with punctures dense, separated, at least on disc, by less than 0.5 times a puncture width (Fig. 33) (Brava).... ***T. aistleitneri* sp. n.**
- 6 Apical depression of fifth tergum bare medially, rarely with few punctures with short seta; second metasomal tergum with lateral white patch L-shaped (as on first tergum) or at least with smaller anterior patch (Fig. 15); mesoscutum with coarse punctures throughout; all white anterior mesoscutal patches well developed (Fig. 15) (Santo Antão) ***T. batelkai* sp. n.**

- Apical depression of fifth tergum with several distinct seta-bearing punctures; second metasomal tergum with lateral patch wider than long, without anterior secondary patch and never L-shaped (Fig. 24), but rarely with few white setae in this area; mesoscutellum with finer punctures at least basomedially; white anterior mesoscutal patches, especially paired *mls* (mediolateral mesoscutal), greatly reduced to a few short setae (São Nicolau) *T. schwarzi* sp. n.
- * The Santiago females of *T. denolii* are much larger, probably because of the larger host, and differ slightly in the shape of the pygidial plate. We presently interpret this as merely minor variations in the absence of more conclusive evidence suggesting a separate species status for the Santiago population.
- ** It seems unusual that there is a single female from S. Nicolau that is clearly of *T. denolii*. Refer to the account for that species regarding this single individual which is perhaps mislabeled. However, this specimen of *T. denolii* is unique for its L-shaped white patch on the second tergum. More material is needed in order to permit a more thorough understanding of their variability.

Subfamily Nomadinae Latreille

Tribe Ammobatini Handlirsch

Genus *Chiasmognathus* Engel

The genus *Chiasmognathus* comprises a series of small ammobatine bee species which are exclusively cleptoparasitic in the nests of Nomiodini (Engel 2006, 2007, 2008a, 2008b, 2009, 2010). Although few species have been characterized, the genus is likely quite diverse perhaps with numerous undescribed species occurring wherever there are nesting aggregations of *Nomioides* Schenck or *Ceylaliectus* Strand. The biology and immature stages of a single species have been studied in Pakistan (Rozen 2008). The discovery of the new species described here brings the described diversity of the genus up to 11 species, the new one being the most westerly of the known taxa, although new species are being discovered semi-regularly (Engel pers. obs.). *Chiasmognathus batelkai* appears to victimize nests of *C. capverdensis*. Vouchers of the host species can be found in the EAFC, SEMC, NMPC, and JSPC. Interestingly, even at 3.2–4.2 mm in length, *C. batelkai* represents a case of island ‘gigantism’ as this is the largest known species of the genus.

Chiasmognathus batelkai sp. n.

urn:lsid:zoobank.org:act:4ED85B90-4C8B-47B7-B96D-CF4A7061A7C0

http://species-id.net/wiki/Chiasmognathus_batelkai

Figs 35–43

Holotype. ♂, Cape Verde Isl., Santo Antao, 1382 m, Espungeiro, 13.X.2009 [13 October 2009], 17°06'17"N, 25°05'21"W, J. Straka & J. Batelka lgt. (SEMC).



Figures 35–36. Male habitus of *Chiasmognathus batelkai* sp. n. **35** Lateral **36** Dorsal.

Paratypes. São Vicente: 1♂, Cabo Verde 00/25, Ilha de S. Vicente, Calhau – Baia d. Gatas, -5 m, 13.12.2000 [13 December 2000], leg. Aistleitner (EAFC); **Santo Antão:** 5♂♂, same data as holotype (FISC, JSPC, SEMC); 3♂♂, 4♀♀, same data as holotype except 12–13.X.2009 [12–13 October 2009], 17°06'N, 25°05'W (JSPC, SEMC).

Diagnosis. The new species is the largest of the known *Chiasmognathus*, being 3.2–4.1 mm in total length in females and 3.5–4.2 mm in males. The ocellar elevation in males is distinctly more prominent than in any of the other species, this and the combination of the size, mesoscutal sculpturing, and coloration (Figs 35, 36, 42, 43) will serve to identify *C. batelkai* from the other species of the genus, particularly those occurring in Africa (Engel 2010, pers. obs.: Niger and undescribed species from Kenya).



Figures 37–41. Male terminalia of *Chiasmognathus batelkai* sp. n. **37** Seventh metasomal sternum **38** Eighth sternum **39** Genital capsule, dorsal view **40** Genital capsule, lateral aspect **41** Genital capsule, ventral view.

Description. ♂: Total body length 4.0 mm (3.5–4.2 mm); forewing length 3.3 mm (3.1–3.7 mm). Head wider than long (width 1.3 mm, length 0.99 mm); inner margins of compound eyes straight, convergent below; apex of clypeus at lower tangent of compound eyes; ocelli above upper tangent of compound eyes, ocellar triangle particularly prominent, swollen above curvature of head (more so than in other species of the genus); clypeus weakly convex, nearly flat, apicolateral corners of clypeus with small patches of tightly packed, elongate, apically-sinuate setae; malar space vestigial; mandibles simple, crossing in repose but not covering labrum; frontal line carinate

from just below lower tangent of antennal toruli to median ocellus. Mesoscutum with median line deeply impressed and wide, width about that of mesoscutal puncture diameter, extending to just before mesoscutal midlength. Intertegular distance (i.e., distance between inner margins of tegulae) 0.8 mm (0.7–0.9 mm). Forewing marginal cell broadly truncate; both m-cu crossveins entering second submarginal cell. Male terminalia as depicted in Figures 37–41.

Integument generally shining and smooth (Fig. 36). Labrum with punctures over entire surface, punctures nearly contiguous, integument between punctures (where evident) smooth; clypeus with shallow punctures separated by 0.5–1.5 times a puncture width centrally, punctures separated by less than a puncture width laterally; face and vertex with punctures nearly contiguous and more well defined than those centrally on clypeus, integument between (where evident) smooth, punctures on vertex posterior to ocelli somewhat weaker; punctures on gena as on sides of vertex with punctures gradually becoming more widely spaced ventrally; postgena with smaller and weaker punctures separated by 1–4 times a puncture width, integument otherwise smooth but duller than shining integument elsewhere on head. Mesoscutum punctate, anteriorly and around median line punctures separated by 0.5 times a puncture width, infrequently more widely spaced, otherwise punctures of mesoscutum separated by 1–2 times a puncture width, infrequently by less; mesoscutellum with punctures separated by 0.5 times a puncture width except in paramedial areas of disc distinctly more sparse, separated there by 1–5 times a puncture width; metanotum with punctures separated by less than a puncture width; preëpisternal area with punctures more coarse than those of mesoscutum, nearly contiguous; hypoepimeral area with small punctures separated by 0.5–3 times a puncture width, ventrally with largely impunctate area bordering scrobe; mesepisternum with punctures separated by 0.5–2 times a puncture width anteriorly, posteriorly punctures more coarse and closer, often nearly contiguous, becoming more widely spaced ventrally; metepisternum with punctures separated by less than a puncture width above, punctures becoming more widely spaced ventrally; propodeum with short and narrow basal area coarsely imbricate and impunctate, otherwise integument with punctures separated by less than a puncture width. Metasomal terga and sterna finely imbricate, with scattered weak, small punctures, apical margins impunctate.

Integument of head and mesosoma black and shining (Figs 35, 36) except reddish brown on mandibular apex, brown on middle third of mandible, light brown on palpi and glossa, dark brown to black on labrum (some males with reddish brown laterally on labrum), dark brown to black on antennae, dark brown on tegula, and dark brown on legs except lighter on tarsi and at femorotibial and tibiobasitarsal joints. Wing veins brown except C and Sc+R dark brown; membranes hyaline, forewings faintly infumate. Metasoma dark brown except first tergum dark reddish brown in apical two-thirds to one-half; apical margins of terga narrowly brown to light brown.

Pubescence silvery white. Head with numerous, fine, appressed to subappressed plumose setae, such setae nearly obscuring integument of face around and below level of antennal toruli, and intermingled with a few suberect to erect finer, simple setae;



Figures 42–43. Female habitus of *Chiasmognathus batelkai* sp. n. **42** Lateral **43** Dorsal.

such appressed plumose setae present on gena. Setae of mesosoma like those of head although more sparse centrally on mesoscutum and mesoscutellum; setae similar to those of gena on pleura (although longer and more diffuse to sparse centrally on mesepisternum), metanotum, and dorsolateral portions of propodeum. Metasoma with sparse, erect to suberect, short simple setae, without prominent apical fasciae composed of appressed, plumose, white pubescence; first metasomal tergum with small, weak apicolateral patches of appressed to subappressed plumose setae; succeeding terga with similar patches although often more diffuse or narrower than those of first tergum.

♀: As described for the male except in usual gender differences (Engel 2006, 2009) and as follows: Total body length 3.2–4.1 mm; forewing length 2.9–3.9 mm. Ocellar triangle not as prominent as in male. Intertegular distance 0.7–1.0 mm.

Metasomal terga and sterna finely imbricate, with sparse weak, minute punctures, apical margins impunctate, often broadly so.

Coloration as in male except often protibia brown as on tarsi rather than dark brown as on other more basal podites; metasoma dark brown except first tergum largely reddish brown in apical two-thirds to one-half (Figs 42, 43); apical margins of terga reddish brown to brown, most prominently so on second tergum, less so on more apical terga and sterna.

Etymology. The specific epithet is a patronym honoring Jan Batelka, a prominent collector of the new species, authority on the systematics of beetles, and good friend.

Discussion

It appears as though the Cape Verde Islands fauna of *Thyreus* represents a single invasion of the archipelago with subsequent speciation across the islands. All these species resemble *T. hohmanni* Schwarz endemic to the Canary Islands (another Macaronesian archipelago) and the more widespread *T. ramosus*. It is possible that the *Thyreus* of Cape Verde came from the Canary Islands, and follow a similar pattern of relationship and introduction as is described for some plant species (Kim et al. 2008), and it is similarly probable that all endemic macaronesian *Thyreus* share a nearest common ancestor within populations of *T. ramosus* s.l. and to the exclusion of other congeners. It certainly appears as though the bees have moved among the islands, perhaps during sea level regressions when distances would have reduced, speciated and then again dispersed, with cycles of this giving the present distributions of the species (Map 1). It is interesting to note that although the populations of *T. denolii* across Sal, Boavista, and Santiago are relatively isolated, they do not differ significantly in any observed morphological features. If all of these island populations do belong to the same species as we have treated them herein, then *T. denolii* is parasitic on three different host species of *Amegilla* (Engel and Straka in prep.). Conversely, two different cuckoo bee species, *T. batelkai* and *T. schwarzi*, share identical host species. This suggests that the pattern of speciation in the Cape Verde *Amegilla*-*Thyreus* host-parasite complex is not a simple co-evolutionary scenario but instead reflects a complicated history intermingling factors such as probably different times of introduction of host (earlier) and parasite (later) populations, differential spread across the islands, and changing sea levels. The sea level between some islands is shallow (particularly the waters between Sal and Boavista, between the Barlavento islands, and among the Sotavento islands), and Sal and Boavista might have been connected in the geological past (Ramalho et al. 2010). This complex geology would bring populations together more readily than simply during storms or other dispersal events, and, in combination with other factors, would lead to a

complex system of periods of more stable isolation and contact. Certainly a great deal of work remains to be undertaken before conclusive statements can be made in regard to the evolutionary history of these species and the collection of genetic data would be a nice supplement to such research.

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